LIBRARY
15 JUL 1947
U.S.A. 146
Exch
pp 42-4

Mosquito News

Published Quarterly
by the
AMERICAN MOSQUITO CONTROL ASSOCIATION

VOLUME 7 MARCH, 1947 NUMBER 1

CONTENTS

ARTICLES PAGE

A Machine for Digging New or Recutting Old Salt Marsh Ditches in Cape May County (New Jersey) ..... Thomas D. Mulhern and O. W. Lafferty 1
Pre-Hatching Applications of DDT Larvicides on Floodwater *Aedes* Mosquitoes. W. W. Yates and C. M. Gjullin 4
Mosquito Control Problems in Japan ..... Harold F. Gray 7
The Nonspreading of Larvicidal Oils on Florida Waters. R. W. Burrell, C. C. Deonier and C. B. Wisecup 11
Comparative Tests with DDT and Phenothiazine Against Two American and Three New Guinea Species of Mosquito Larvae ..... R. W. Bushland 14
"Insect Control With DDT" ..... Prof. Victor K. LaMer 18

ASSOCIATION NEWS

Report of the May 24–25, 1946 Meeting, Continued 22
The Significance of Particle Size in Sprays and in Aerosol Fogs ..... R. D. Glasgow 22
Technique Employed in the Study and Measurement of Aerosol Fog Droplets ... D. L. Collins 29

NEWS AND NOTES 36

EDITORIAL SECTION

A Permanent Fund for the American Mosquito Control Association ..... R. D. G. 41

REVIEWS AND ABSTRACTS

Los Anofelinos de la Isla de Gran Canaria. By J. M. Romeo Viamonte ..... Helen Sollers 42
Nota Previa Sobre un Nuevo Metodo de Lucha Antilavaria con el Hexacloruro de Benceno (666). By Alvaro Lozano Morales ..... H. S. 42
Insect Microbiology. By E. A. Steinhaus ..... W. B. Herms 42
The Insecticide Situation. By F. C. Bishopp ..... S. J. Carpenter 42
War Losses Among Insect Collections and Entomologists in Japan. By C. L. Remington ..... Louise Goode 43
Pérdidas de Colecciones de Insectos y Entre los Entomólogos en el Japón Debidas a la Guerra. By C. L. Remington. (Spanish translation of review in English) 43
Aedes atropalpus (Coq.) A New Mosquito Vector of *Plasmodium gallinaceum* Brumpt. By H. L. Trembley. L. G. 43
Aedes Atropalpus (Coq.) Un Nuevo Mosquito Vector del *Plasmodium gallinaceum* Brumpt. (Spanish translation of review in English) 44
Contribución al Estudio de la Biología del *"A. maculipennis* var. *atroparvus"* en Función del Ambiente. Densidad y Ciclo Anual. By Alvaro Lozano Morales ..... Don M. Rees 44
Contribución al Estudio de la Biología del *"A. maculipennis* var. *atroparvus"* en Función del Ambiente. Densidad y Ciclo Anual. Por el Doctor Alvaro Lozano Morales. (Spanish translation of review in English) 44
Le Froid et les Facteurs d'Éclosion de l'Oeuf chez l'*Aedes geniculatus* Oliv. By E. Roubaud and J. Colas-Belcour ..... Donald MacCreary 45
El Frió y los Factores en la Incubación de los Huevos del *Aedes geniculatus* Oliv. Por E. Roubaud y J. Colas-Belcour. (Spanish translation of review in English) 45
Studies on Brazilian Anophelines from the Northeast and Amazon Regions. By O. R. Causey, L. M. Deane and M. P. Deane ..... Robert Matheson 45
Estudios sobre Anofelinos Provenientes del Noreste del Brasil y de la Región Amazónica. (Spanish translation of review in English) 46

GENERAL BIBLIOGRAPHY ..... H. H. Stage 48

LIST OF ADVERTISERS 47

ADVERTISING RATES 21

MOSQUITO NEWS

Official Organ of the American Mosquito Control Association

EDITORIAL BOARD

Editor, R. D. Glasgow, Albany, New York

Associate Editor (Make-up and Production), D. L. Collins, Albany, N. Y.

Associate Editor (Current Bibliography—"References to Literature of Interest to Mosquito Control Workers"), H. H. Stage, Washington, D. C.

Associate Editor (Reviews and Abstracts), Helen Louise Trembley, Bethesda, Md.

Business Manager, C. T. Williamson, Yaphank, New York

Secretary-Treasurer of the Association
T. D. Mulhern, New Brunswick, N. J.

PUBLICATIONS COMMITTEE

R. D. Glasgow, Chairman, Albany, N. Y.
C. T. Williamson, Yaphank, N. Y.
T. D. Mulhern, New Brunswick, N. J.
H. H. Stage, Washington, D. C.
Robert Matheson, Ithaca, N. Y.
J. T. Hart, Morris Plains, N. J.

Published by
AMERICAN MOSQUITO CONTROL ASSOCIATION

Printed by
Boyd Printing Company, Inc., Albany, N. Y.

A quarterly journal published on the 20th of March, June, September and December. Devoted to the improvement and the sound extension of mosquito control and related work as a vital public service.

SUBSCRIPTION RATES

$3.00 per Year (U. S. money), Single Copies, 75 cents.
Mailed without charge to members of the Association.

MEMBERSHIP DUES

Associate Members $2.50
Active Members 4.00

BUSINESS COMMUNICATIONS

Communications relating to editorial matters and manuscripts submitted for publication in Mosquito News should be addressed to Boyd Printing Co., 374 Broadway, Albany 7, N. Y., or to Dr. Robert D. Glasgow, Editor, Mosquito News, New York State Museum, Albany, New York.

Communications relating to advertising space should be addressed to C. T. Williamson, Business Manager, Mosquito News, c/o Suffolk County Mosquito Extermination Commission, Yaphank, New York.

Communications relating to subscriptions to Mosquito News, Membership in the American Mosquito Control Association, and other association matters should be addressed to Thomas D. Mulhern, Secretary-Treasurer, American Mosquito Control Association, New Brunswick, New Jersey.

Application for entry as second class matter at the Post Office at Albany, N. Y., pending.

Copyright 1947 by
The American Mosquito Control Association

ARTICLES

A MACHINE FOR DIGGING NEW OR RECUTTING OLD SALT MARSH DITCHES IN CAPE MAY COUNTY (NEW JERSEY)

THOMAS D. MULHERN
Admin. Asst. Grade I, New Jersey Agricultural Experiment Station
AND
O. W. LAFFERTY
Cape May County Mosquito Extermination Commission, Cape May Court House, New Jersey

Cape May County has over 50,000 acres of salt marsh and more than 10 million feet of salt marsh mosquito control ditches. The existing ditches should be recut periodically, and changes and additions should be made each year in the existing ditching system for best results. Much of this work was formerly done by hand labor. During the war years there was an acute labor shortage in this region, and the commission was unable to maintain a full schedule of ditch repair work. More recently, rising labor costs and a continued labor shortage have made it apparent that machinery must be utilized if the drainage system is to be returned to maximum efficiency at reasonable cost.

The commission was in possession of a machine which had been built several years previously for service in cleaning ditches only. This had never been used much because the tracks with which it was fitted were too narrow (24" wide) for satisfactory operation on the softer marshes in Cape May County, and the screw conveyor type excavating unit was not able properly to recut ditches that were almost completely grown over with new sod or were completely full of silt. At the request of the commission, a design was prepared for converting this machine to the same type as the experimental machine previously built by the New Jersey Agricultural Experiment Station (1) and tried out in Cape May County. The converted unit can be used for cleaning old ditches no matter how badly overgrown they may be, or for digging new ditches.

Anderson Machine Works of Wildwood, New Jersey, was employed to do the work under the direction of the authors. Figure 1 is a view of the original machine before the conversion was begun. Figure 2 is a view of the converted machine and Figure 3 shows the work done by the new unit.

The conversion required the following operations:

(a) Discard old screw conveyors, troughs, and drives.
(b) Move tractor engine, transmission and differential forward in chassis.
(c) Rebuild crawler frames, eliminating yokes and forward portions of frame, which would limit the width of tracks which might be used. Build new front and rear attachment axles to suit rebuilt crawler frames.
(d) Replace old track shoes, which were 24" long with new shoes 36" long, thereby increasing tread area by 50 per cent, and decreasing ground pressure in proportion, to allow operation on soft marshes.
(e) Build and install entirely new ditch digging and cleaning unit, patterned after unit employed on experimental ditching machine previously developed by the New Jersey Agricultural Experiment Station.

Specifications of the new machine are as follows:

A MACHINE FOR DIGGING NEW OR RECUTTING OLD SALT MARSH DITCHES IN CAPE MAY COUNTY (N. J.)

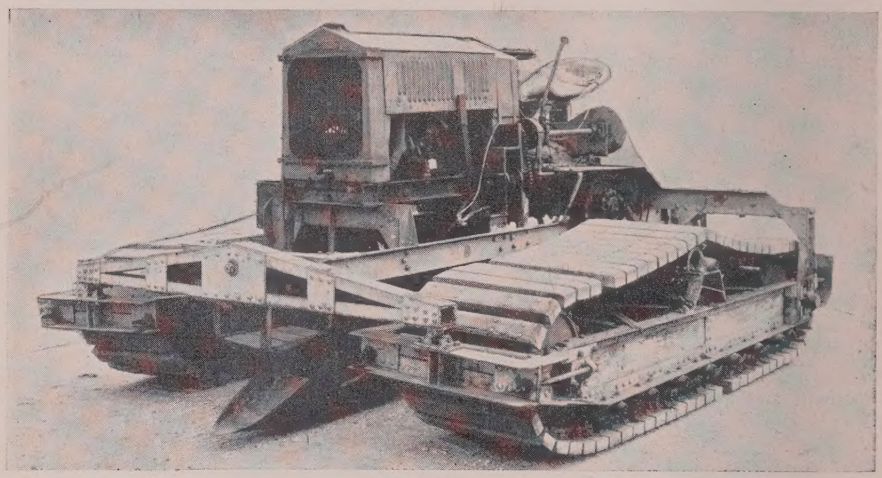


FIG. 1. Photo M 11–107. Cape May "Cletrac" ditch cleaning machine as originally furnished for ditch cleaning only.

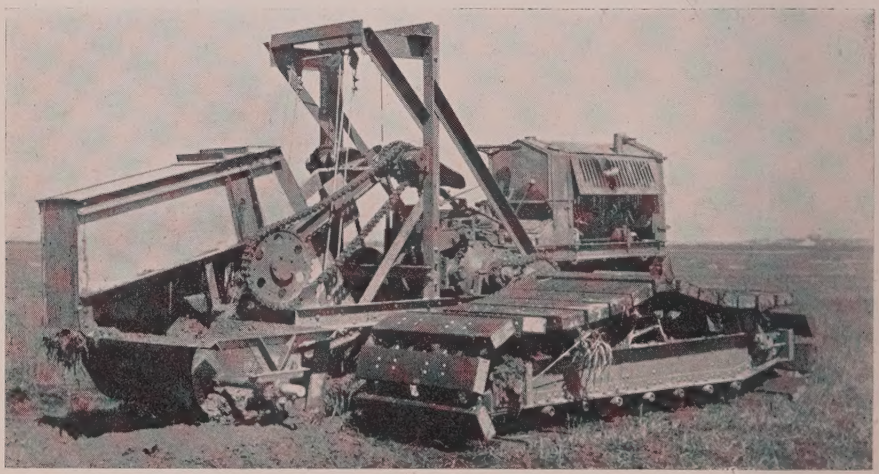


FIG. 2. Photo M. 11–122. Close up view of converted machine with digging unit in position to dig 20" deep ditch. Spoil is discharged on meadow surface back of near track.

Power plant—Cletrac tractor, Model B, gasoline.
Steering—by brakes in differential, foot pedal controlled.
Operating speeds—new ditching hard meadow, 20 feet per minute; new ditching soft meadow, or ditch cleaning, 40 feet per minute.
Ditch size—10″ wide, 12″ to 24″ deep, vertical banks.
Weight—6 tons.
Length of contact of track on ground—98″.
Width each track—36″.
Track area in contact with ground—7,056 sq. in.
Bearing pressure on ground—1.7 pounds per sq. in.
Type digging unit—continuous conveyor chain with digging buckets.
Speed—400 ft. chain, 600 buckets, per minute.
Buckets—Type C, 10″ long x 5″ wide x 4″ deep. Each bucket cuts a slice of meadow sod only ½″ thick, so the spoil is finely ground rather than in chunks.
Bucket chain—conveyor chain, pintle type, No. H124, malleable iron with steel pins.
Discharge—by centrifugal force at top of flight of buckets, into cross conveyor, screw type.
Conveyor—10″ dia. screw, 200 r.p.m., operating in flared trough.

The machine was placed on the marsh in May of 1946. After a few weeks of operation, during which all design specifications were met, it was laid aside during the mosquito breeding months while all personnel of the Commission was engaged in summer work. Since the close of the mosquito flight season, the machine has been used to good advantage for both new ditching and recutting, much of the service being under unusually severe conditions in marshes near the seashore where the sod contains a high proportion of sharp sand and is generally underlain at a depth of 18 to 24 inches with solid sand. Because of the severe operating conditions, wear in the bucket chain and the buckets and the bearings in the digging column has been unusually great; nevertheless, the machine has given very satisfactory service, and has shown the ability to cut as much as 1,200 linear feet of ditch per hour and to recut old ditches at twice that rate. Under reasonably good working conditions, where there is not too much idle travel from ditch to ditch, detours around streams and impassable holes, etc., it is possible to dig a mile of ditch per day with the machine and a crew of men. This is equivalent to the

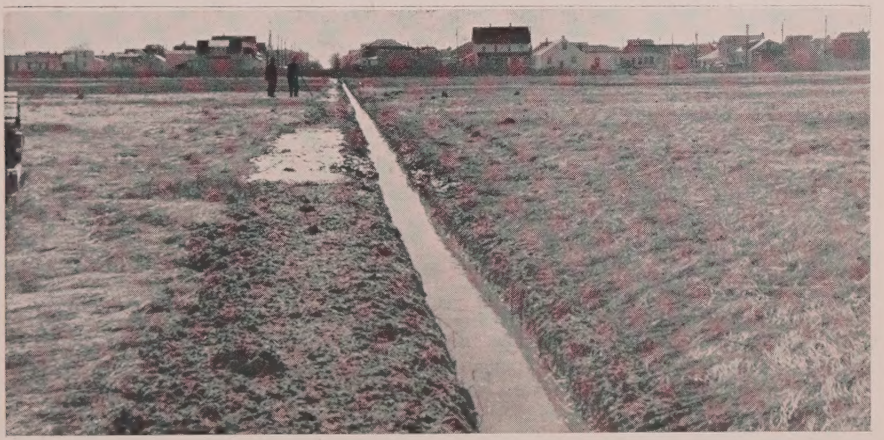


FIG. 3. Photo M 11–125. Work done by converted machine. Ditch cleaned, widened, and deepened.

work of a hand labor crew of about 25 men working under 1946 conditions.

(Note—A new design for a machine based on the same principles but employing sealed roller and ball bearings, hydraulic lift, enclosed chain drives and other improved features has been prepared, and the design has been approved by the special Machine Committee of the Associated Executives of Mosquito Control Work in New Jersey. A machine based on the new plans is now under construction for the Ocean County Mosquito Extermination Commission for trial and use beginning in the spring of 1947.)

Reference

(1) A Further Development in Machinery for Digging and Cleaning Salt Marsh Ditches. (Proceedings of the 29th Annual Meeting of the New Jersey Mosquito Extermination Association, held at Atlantic City, New Jersey, on March 11, 12 and 13, 1942.)

PRE-HATCHING APPLICATIONS OF DDT LARVICIDES ON FLOODWATER *AEDES* MOSQUITOES

W. W. YATES AND C. M. GJULLIN
U. S. D. A., Agr. Res. Adm., Bureau of Entomology and Plant Quarantine, Corvallis, Oregon

The Columbia River is bordered by extensive areas that are flooded by the annual rise of this river. These areas produce large numbers of *Aedes vexans* (Meig.) and *A. lateralis* (Meig.) mosquito larvae. The amount of low land covered and the time the flood crest is reached varies from year to year. In some years the rise is gradual, whereas in others it is rapid, or there may be several rises and recessions before the crest is reached. The highest stage usually comes in May or June, but often the several rises cause large numbers of larvae to hatch earlier than this. These variations cannot always be forecast with certainty, and an effective pre-hatching treatment must be of such a nature that it can be applied several days or weeks before the land is flooded. It must withstand considerable rainfall and weathering and still be lethal to the emerging larvae.

The application of various materials to the ground seeded with eggs prior to hatching has been tried on floodwater *Aedes* mosquitoes in the Columbia River area in previous years without success. This paper gives the results of field tests made with DDT in an oil solution and in an emulsion.

A few preliminary tests were made in 1944 and 1945 with 5 per cent of DDT in Diesel oil. In 1946 more extensive tests were made, using both types of preparations. The emulsion was prepared by diluting a stock containing 25 per cent of DDT, 68 per cent of xylene, and 7 per cent of Triton X-100 (an aralkyl polyether alcohol) with seven parts of water. Two plots were treated with this emulsion. The sprays were applied with either a hand compressed-air sprayer or a knapsack sprayer. Most of the areas were covered with low brush or grass, or dead rank vegetation of the previous year's growth; in some places there was considerable ground litter of stumps, logs, and dead branches.

TABLE 1. Results of Field Tests With Pre-Hatching Applications of DDT Larvicides on Floodwater *Aedes* Mosquitoes.

Plot No.	Material Applied per Acre: Pounds of DDT	Material Applied per Acre: Pints of Liquid	Acres Treated	Date Treated	Number of Larvae[1] from Soil Samples	Days Between Treatment and Flooding	Results
				1944			
1	0.1	1	0.5	May 26	8	18	No apparent reduction in numbers
2	.1	.5	.25	26	185	18	
3	.2	.3	.07	26	220	18	A few appeared affected but mortality low
				1945			Second and third instar larvae numerous, but untreated areas had been flooded
4	.5	5	.5	May 9	22[2]	5	
5	1	4.5	.25	9	90	5	
6	2	13.3	.33	15	Numerous	6	
7	2	10	.25	15	do	6	
				1946			
8	2	10	.25	April 22	114	2	
9[3]	2	8.5	.1	22	132	2	All killed
10	3	6.5	.125	22	109	14	
11	1	2.8	.15	22	205	21	
12	1	3.8	.2	23	905	22	
13	2	6	.16	23	62	31	
14	3	5.7	.1	23	52	33	Inconclusive; only a 24-hour check obtained
15[3]	3	10	.11	March 1	415	40	
16	3	25.5	.45	21	4600±	49	All killed
17	1	3.75	.2	21	6300±	51	
18	2	18.5	.5	21	3600±	54	Inconclusive owing to rapid rise of water. One side showed reduction of larvae

[1] Average count of larvae from either 2 or 3 samples of 3 quarts of soil.
[2] Larvae check from small area already flooded.
[3] These plots treated with 25% emulsion diluted 1 to 7.

Table 1 gives the results of these tests. The small amount of DDT applied in 1944 was not effective when the treated areas were flooded 18 days after application. In 1945 more DDT was applied, and the treatments were more effective. On plots 1 and 2 results were not conclusive, because the rapid rise of the river flooded adjacent areas before a check could be made, and larvae drifting into the area were not killed. Applications of 2 pounds of DDT per acre killed all the first instar larvae, but the time that elapsed between application and flooding was short.

In 1946 eleven plots were treated 2 to 54 days before the areas were flooded. It was impossible to obtain satisfactory checks on two plots because of the rapid rise of the river. Good kills were obtained in the other nine plots with 1, 2, or 3 pounds of DDT per acre. The oil solution and the emulsion gave equally good results. Newly hatched larvae could be found in the plots from a few hours to 24 hours after they were flooded, but 48-to-72-hour checks showed that all were dead. In plots 8 and 9 all first and second instar larvae that drifted into the area from adjacent untreated ground were killed. In plots 10 and 11 about half the fourth instar larvae brought in by the rising water were killed. In the latter plot the water advancing up the swale above treated ground killed many emerging larvae. On plot 17, on which 1 pound per acre was applied 51 days before the plot was flooded, larvae hatching in the area were killed, but third instar larvae entering from untreated areas were not affected. Fourth instar larvae that came into plot 12, where the same quantity of DDT had been exposed for 22 days, were also unaffected. A few dead or affected pupae that had drifted into several treated plots were seen, but most of the pupae were not seriously injured.

Observations were also made on the effect of these DDT applications on other aqueous organisms. In plots 1 and 2, which were flooded soon after treatment, dead beetles and other aqueous forms were found the first day after flooding, but after the water had spread out and covered more area live organisms were present. Where the time between application and flooding was longer, live beetles, cyclops, water fleas, small carp ¼ to ¾ inch long, and other water life were abundant.

In November 1946 soil was again taken from plot 16, which had received 3 pounds of DDT as an oil spray in April 1946. Two quart samples of this soil hatched several hundred larvae when flooded, but most of these died within 48 hours. Repeated trials within additional soil from this area failed to produce larvae that would live beyond the third instar.

All of the low lands along the Columbia River in which the DDT test plots were situated, were flooded in December by unseasonable high waters of the river. No larvae hatched in these winter floods. In January 1947 soil was collected from plot 16, and also from plot 15, which had the same amount of DDT in the form of an emulsion. These samples were compared with soil taken from an area that had not been treated with DDT. Many larvae hatched in all of these samples. The larvae in the check samples were vigorous, and within 5 days they had reached the fourth instar. Larvae from the two treated areas appeared normal for about 24 hours and then started to die. Within 48 hours most of them were dead, and none lived beyond third instar.

From these tests it appears that under conditions found along the Columbia River, an application of 3 pounds of DDT per acre will leave a residue in the soil nine months later that is toxic to newly-hatched larvae, even after the ground has been covered with water two times.

MOSQUITO CONTROL PROBLEMS IN JAPAN*

HAROLD FARNSWORTH GRAY,† GR.P.H.
Engineer, Alameda County Mosquito Abatement District, Oakland, California

People who have lived from infancy in areas of heavy mosquito infestation become inured to insect attack and more or less indifferent to their presence. This is particularly true where the presence of large numbers of mosquitoes is connected with the production of the basic food supply. In Japan, as in many oriental countries, rice is the staple food, and the rice fields produce tremendous numbers of mosquitoes each summer.

While rice growing is responsible for the greatest production of mosquitoes, the Japanese provide plenty of breeding places for mosquitoes in their cities and towns, with the result that both rural and urban areas are infested. As the Japanese houses are not screened, mosquitoes are a commonplace condition, indoors or outdoors in the evening and at night. Prior to the American occupation, little or nothing was done to control them. A considerable period of education will be necessary before the Japanese people will develop any strong desire to eliminate these pests and disease transmitters.

Basically, the mosquito control problem in Japan can be divided into three main sections:

1. The rice field problem
2. The container problem
3. The foul water problem

In the first section, the two principal species are *Anopheles hyranus sinensis* and *Culex tritaeniorhynchus*. The first is the malaria vector in Japan, and the second is the presumed and probable vector of Japanese B encephalitis.

In the second section, the principal species are *Aedes albopictus,* the dengue vector, and *Aedes togoi.* A very few *Aedes aegypti* have been found on one small island off the coast of Kyushu Island.

In the third section the principal species are *Culex pipiens pallens* and *Armigeres obturans.* On Kyushu Island *Culex quinquefasciatus* is also fairly numerous.

It is only necessary to fly over the Japanese islands to appreciate at once the magnitude of the rice field mosquito control problem. Except in the mountains, the rice fields are everywhere, and rice growing is obviously the dominant agricultural pursuit. Even in mountainous areas, rice is grown on terraces in the steep, narrow valleys. In view of the tremendous extent of the rice fields, several factors concerning mosquito control therein are at once apparent.

1. As rice is the basic staple food of the islands, the methods of mosquito control adopted must not curtail or damage the rice crop.
2. In a country where poverty among the rural people is normal, and where as a result of war the entire nation is impoverished, any mosquito control methods must be very low in cost.

Other factors which become apparent on further study of the problem are:

3. The Japanese have practically no governmental employees who are reasonably well trained in sanitation, and particularly in mosquito control, especially at the local and provincial levels. Therefore mos-

---

* Representing work done for the Commission on Virus and Rickettsial Diseases, Army Epidemiological Board, Office of the Surgeon General, U. S. Army.

† Mr. Gray (who is also Lecturer in Public Health in the University of California) was sent to Japan during the summer of 1946 by the Surgeon General of the United States Army as Consultant to the Secretary of War, to work with the Commission on Virus and Rickettsial Diseases, Army Epidemiological Board, on problems of mosquito control affecting our military forces and the Japanese civilian population. The members of the Commission present in Japan at the same time were Albert B. Sabin, M.D. (University of Cincinnati), Field Director, and R. Walter Schlesinger, M.D. (University of Pittsburgh), virologist.

quito control measures must be reasonably simple in principle and in method of application, and be capable of being applied by rice-farmers and local government officials who have little technical training.

4. The comparative scarcity of mechanical or power equipment precludes the possibility of using some methods which are very effective under American conditions (airplanes, power sprayers and excavators).
5. The cost of application of larvicides would be very high in relation to the net income of the agricultural population.

The only immediately apparent possible control measures appear to be a cyclic intermittent flooding and draining of the rice fields during the growing season, and possibly the introduction of larvicidal fish, such as *Gambusia affinis*. Both methods have been recommended for preliminary trial in circumscribed areas, on an experimental basis. The idea of intermittent drying is not new to the Japanese, but intermittent drying in predetermined cycles for the control of mosquito breeding apparently has not occurred to them. The government can establish such cycles and enforce them. Neither is the idea of fish in the rice fields new in Japan, but the fish at present are food types, and they are of little effect in controlling mosquito breeding.

It is not probable that either of these methods, alone or in combination, will completely control mosquito breeding in the rice fields, but they should reduce the output very greatly, probably to a point where the mosquitoes would not be an appreciable factor in disease transmission. In limited areas where either malaria or encephalitis is a problem, supplemental larviciding, plus DDT residual spraying of houses and animal quarters, may be necessary and may be a justifiable expense.

The endemic malaria areas are rather limited in extent and occur principally in central Honshu. It is probable that malaria cases will increase appreciably during the next few years, due to infected military personnel repatriated from tropical regions. Encephalitis has been at a low ebb since 1942, but even in years of greatest prevalence it was limited in its highest incidence to the prefectures along the Inland Sea.

A reasonable reduction in numbers of the two rice field species would certainly make a worth while contribution to human comfort and efficiency in the rural areas of Japan, as well as helping greatly to reduce disease prevalence.

The container breeding group of mosquitoes in Japan is more important than had heretofore been anticipated. Prior to the war, dengue fever had not occurred in the main islands, but in 1942 it appeared as a small epidemic at Nagasaki, and in 1943 and 1944 spread greatly, eventually reaching as far north as a little beyond Tokyo. It appears probable that there were about half a million cases of dengue in Osaka in 1943. Nothing is known or can be surmised as to its prevalence in 1945, owing to the destruction of the Japanese cities, the loss of medical records, and the displacement of the population. It was practically absent in 1946.

The dengue vector in Japan is *Aedes albopictus,* which is quite numerous on Honshu Island as far north as a little north of Tokyo, and on Kyushu and Shikoku Islands, and on the Ryukius. It is typically a breeder in clean water in all kinds of containers, especially under shade or part shade. Its close relative, *Aedes togoi,* which is one of the most numerous mosquitoes in the islands, breeds under similar conditions but appears to stand more sunlight.

Probably both *albopictus* and *togoi* were far more numerous than normal in Japanese cities during the war, for the reason that a large number of houses had concrete tanks (about 3′ x 2′ x 2′) for holding water for fire protection. Judging by the results, these tanks were of little help to the Japanese, but were

a tremendous help to the mosquitoes. One of the first steps in the occupation was a requirement that these water tanks be turned upside down, or broken, or filled with earth, and this directive was fairly well complied with, so that the prevalence of *albopictus* and *togoi* in 1946 was apparently much less than normal.

Further prolific breeding sources of *albopictus* and *togoi* are the numerous cemeteries. Some of these, for example at Kobe, are tremendous. Each monument has several depressions and holes in the stone, which contain water practically throughout the year, and in addition, narrow conical flower holders are stuck in the ground in front of the monument. Each bit of water may contain only a few larvae, but the aggregate output of mosquitoes is apparently enormous. This condition has been fairly well corrected by requiring the cemetery caretakers to fill all these holes with coarse sand or fine gravel.

The Japanese are not peculiar in using cemeteries as mosquito nurseries. Most so-called civilized people do so. It is a strange commentary on human intelligence that the graves of the dead are permitted to bring death, disease and discomfort to the living.

The foul-water group of mosquitoes has breeding habits which vary from our own domestic *Culex pipiens,* in that these species seem to tolerate more sunlight than does *Culex pipiens (molestus?).* The liquid manure tanks in the rice fields and other agricultural areas are usually uncovered or partly covered and *Armigeres obturans* seems to breed readily there in nearly full sunlight, though it apparently prefers shade. *Culex pipiens pallens* definitely prefers shade or darkness, and is seldom found except in shaded polluted water. With the large numbers of benjos and liquid manure tanks in Japan, plus many other places in which foul water collects, the numbers of these two species is generally great, both in urban and rural districts.

Until the Japanese abandon the use of human excrement for fertilizer or change greatly their present methods of using it, there will be considerable difficulty in controlling these two species in the rural areas and in the unsewered portions of their cities. Several changes in methods have been proposed, including mosquito-proof digestion tanks, and the use of dry composting processes.

Observations on the breeding and feeding habits of the principal species of Japanese mosquitoes indicate that reasonable reductions in numbers, which can be obtained at very moderate expense, should result in an appreciable reduction in mosquito transmitted disease in Japan. For example, *Anopheles hyrcanus sinensis,* the dominant anopheline, has a marked preference for large animals as compared to man. Only its tremendous numbers under uncontrolled breeding makes it an effective malaria vector. Intermittent cyclic drying of the rice fields should result in a reduction of at least 80 per cent in this species, and a rapid drop in the malaria case rate in the endemic malaria areas. The use of DDT residual spraying in animal barns should result in a very obvious further reduction in their prevalence, as these quarters are the favorite day-time roosting places for this species.

Intermittent cyclic drying of rice fields should also effect a great reduction in the numbers of *Culex tritaeniorhynchus,* the presumed and probable vector of Japanese B encephalitis. This mosquito, according to observations made in 1946 at Okayama by Dr. Manabu Sasa, an entomologist employed by the Commission on Virus and Rickettsial Diseases, Army Epidemiological Board, has a definite preference for direct sunlight on breeding water, a fact which explains the appreciable reduction in numbers of this species toward the latter part of the season when the rice has grown sufficiently high to exclude sunlight from the water surface in the rice fields. Cyclic intermittent drying as a control measure would therefore be most important during the early part of the rice growing season.

Dr. Sasa's observations indicate that *Culex tritaeniorhynchus* feeds principally

on man, horses, cows and goats, which suggests again the possibility of this species as an encephalitis vector.

Japanese B encephalitis, while it was present in epidemic form in 1924 and 1935, has apparently been almost absent in Japan in the past several years, and was certainly almost non-existent in 1946. Not a single case occurred in the American forces in Japan, though a few cases did appear among unvaccinated military personnel in Korea. Only one serologically proven case in a Japanese occurred in Japan, and immunological tests on several groups of children indicated that no infection occurred in such groups in 1946. It appears probable that this disease requires very large numbers of vector mosquitoes for effective transmission, and therefore a moderately high percentage reduction in the numbers of *Culex tritaeniorhynchus* may be effective in preventing infection. However, there are too many unknown factors in the epidemiology of Japanese B encephalitis to warrant any positive statements as to its control. A great deal of further research is needed in regard to this rather baffling disease.

It appears very doubtful to the writer that *Culex pipiens pallens* can be an effective vector of encephalitis or any other disease, as it is a very hesitant biter of humans, and appears to be attracted principally to birds, especially chickens. Certainly there is no comparison between it and our fairly aggressive *Culex pipiens (molestus?)* in the United States.

Both *Aedes albopictus* and *Aedes togoi* are fairly aggressive biters, and *albopictus* would not have to be especially numerous to be an effective vector of dengue. It appears probable that the measures now being taken by the Japanese local governments, under the supervision of the American military government teams, should so greatly reduce the prevalence of *albopictus,* and incidentally of *togoi* also, that large epidemics of dengue may be unlikely in the future.

The mosquito control problem in Japan is one of considerable magnitude, but capable of solution in time. A fairly good start has been made on the control of the container breeding species. It should be possible, by the use of intermittent cyclic drying, possibly supplemented by the introduction of larvicidal fish, to very greatly reduce the tremendous numbers of the two disease vector species in the rice fields, within a period of perhaps ten years.

Two principal difficulties present themselves, aside from the inability of the Japanese people to defray the cost of mosquito control by American methods. One is the ignorance of, and indifference to, mosquitoes by most of the Japanese people. This can be overcome by popular education, and the Ministry of Welfare is undertaking a program of education which should be helpful.

The other difficulty is the scarcity in local governments of technically trained sanitation personnel, who can put into effect actual mosquito control programs. It will take many years to train such personnel and get them into the health departments of the local governments. Some small attempts at training Japanese personnel in mosquito and rodent control have been made by the Public Health and Welfare Section under the Supreme Commander of the Allied Powers, particularly a training school conducted at Kyoto in April, 1946, but the surface of this problem barely has been scratched.

Each local government unit is required to have an insect and rodent control team. These teams are supervised in their work by the American military government teams. In some areas good results are being obtained, but in many little or nothing is accomplished.

In summary, Japan has a definite mosquito transmitted disease problem, but owing to impoverishment of the people the means to combat this situation are very limited. Simple and relatively inexpensive measures can be put into effect which should greatly reduce both the health hazards and the discomfort caused by mosquitoes. Time will be required to educate the Japanese people as to the

benefits of mosquito control, and especially to change some of their basic habits in general sanitation. Under American occupation a start is being made toward more healthful and comfortable living in both urban and rural regions.

THE NONSPREADING OF LARVICIDAL OILS ON FLORIDA WATERS

R. W. BURRELL, C. C. DEONIER, AND C. B. WISECUP
U. S. D. A., Agr. Res. Adm., Bureau of Entomology and Plant Quarantine *

During the summer of 1943 intensive small-scale field tests were conducted in central Florida to determine the effectiveness of various DDT formulations on the control of anopheline larvae (1). These tests showed that a promising treatment consisted of spot applications of solutions containing 5 per cent of DDT in fuel oil or used crankcase oil. In September, shortly after the summer rainy season, it was found that the oils were not spreading on many of the roadside ditches, borrow pits, and small ponds in which anopheline breeding was still continuing at a high level.

A preliminary survey indicated that oil would not spread in one out of every four ponds. No particular condition, plant association, or other characteristic could be observed which seemed to be associated with this phenomenon. The oils spread freely in ditches on one side of the road and not on the other side, and on some parts of a pond and not on others. Frequently spreading would occur in the center of an open pond, but as the wind drifted the oil film into the vegetation and flotage where breeding was taking place the oil collected into ropelike masses. In one place, where oil from a drip can was slowly collecting on the water surface, many large larvae were found in the grass only 18 inches from the point where the oil was released.

A more extensive survey was made in early December to determine how widespread and how prevalent such areas were, and to investigate the possibility of overcoming this condition by the addition of spreading agents to the solutions. Four rivers, including the famous Suwannee, 2 cypress swamps, 4 roadside ditch margins of 2 springs, and 10 ponds or small lakes, were treated with kerosene, fuel oil, and used crankcase oil. The spreading properties of these oils were determined by measuring the area covered by a single uniform drop of oil. The results are shown in Table 1.

Kerosene did not spread well on any of the areas, and fuel oil gave a fair spread (13 to 24 inches) on only two of them. Although spreading was fair on 14 of the locations treated with used crankcase oil, on only 5 did this material spread as freely as it had during the summer. The spreading ability of all the oils was greatly improved by disturbing the water surface. This would indicate that some type of inhibiting biological film had formed since the cessation of the almost daily rains.

* This work was conducted under a transfer of funds, recommended by the Committee on Medical Research, from the Office of Scientific Research and Development to the Bureau of Entomology and Plant Quarantine.

TABLE 1. Spreading Properties of Different Oils Applied to 22 Water Areas in Central Florida. December 1943.

Treatment	Number of Areas on Which There Was No Spread of Oil	Number of Areas on Which Oil Spread			
		0–6 inches	6–12 inches	12–24 inches	More Than 24 inches
Kerosene	7	12	3	..	..
Fuel oil	7	9	4	2	..
Used crankcase oil	5	1	2	9	5

A series of 18 wetting agents, at 2 per cent concentrations, were made up with kerosene, fuel oil, and used crankcase oil and tested in a lily-covered pond, a grassy pond, a mossy pond, and a weedy stagnant ditch. In general, marked increases in coverage resulted from the addition of most of these agents to kerosene and to fuel oil, but in only a few of these tests was the spread satisfactory. Used crankcase oil, which spread satisfactorily without additional agents in two locations and showed some spread in the other two, failed to show so decided a response to most of the auxiliary agents as did the lighter oils. The following agents gave most consistent increases in coverage with all three types of oil: Triton X-100 (an aralkyl polyether alcohol); Vatsol OT (a dioctyl ester of sodium sulfosuccinic acid); Nopco 1216 (sulfonated sperm oil); and Triton B-1956 (polyglyceride of a glyptal resin).

In subsequent tests the spreading property of fuel oil was greatly increased by the addition of small quantities of vegetable oils. Castor oil appeared to be the best, closely followed by linseed oil. Unused lubricating oil is normally non-spreading, but when 1 per cent of sulfuric acid was added the mixture covered at least as large areas as did used crankcase oil. The sulfonated products of combustion are probably involved in the spread of used crankcase oil.

A more extensive comparison of the better spreading agents with No. 2 fuel oil was made on 16 ponds at the beginning of the rainy season in 1944. Table 2 shows that better spreading over a greater number of ponds was obtained with the three best synthetic compounds than with the vegetable oils. The action of the spreading agents was rather erratic, different ones spreading more effectively on some ponds than on others.

TABLE 2. Effect of Adding Various Emulsifiers and Other Materials on the Spreading Quality of No. 2 Fuel Oil. July 19–21, 1944

Spreading Agent (2 per cent)	Number of Ponds on Which Oil Spread			
	0–12 inches	12–24 inches	24–36 inches	36–48 inches
None	16	..	..	..
Triton X-100	2	5	4	5
Triton B-1956	2	7	4	3
Nopco 1216	2	6	6	2
Castor oil	3	5	6	2
Linseed oil, washed	4	6	6	..
Oleic acid	4	8	4	..
Tung oil	7	6	3	..
Linseed oil, raw	9	4	3	..
Pine oil (Yarmor 350)	8	8	..	..

The spreading powers of Triton X-100 and of a Span 20 + Tween 20 mixture (equal parts) were compared when used in No. 2 fuel oil alone and in an emulsion concentrate diluted with No. 2 fuel oil. The emulsion concentrate contains 10 per cent of the emulsifying agent and when diluted at the rate of 1 part to 4 parts of No. 2 fuel oil gives a solution containing 2 per cent of the emulsifier. The results of this experiment are presented in Table 3. The pond with stagnant water thick with algae showed the greatest inhibition to spreading. The spread on the permanent pool with old brown grass and smartweed was somewhat better, but for some unknown reason a similar pool with smartweed and float-

TABLE 3. Effect of Adding Various Concentrations of Triton X-100 and Span 20 Plus Tween 20 on the Spread of No. 2 Fuel Oil. Figures Represent Diameter (in Inches) of the Oil Film Resulting from the Application of One Drop of Material. October 1944.

Treatment	Permanent Pools		Temporary Pools		
	Stagnant Water Thick With Algae	Old Brown Grass and Smartweed	Smartweed and Floating Grass	Fresh Clean Water, Grass and Weeds	No Grass	Roadside Ditch Grass and Weeds
Fuel oil alone	2	8	10	4	3	6
Fuel oil plus 2% of emulsifier:						
Triton X-100	6	30	24	24	30	20
Span 20 plus Tween 20 (equal parts)	12	24	30	24	40	36
Fuel oil (4 parts) plus emulsion concentrate (1 part):						
Triton X-100	8	18	30	36	30	18
Span 20 plus Tween 20 (equal parts)	12	20	40	24	36	36
Used crankcase oil	8	12	30	36	24	24

ing grass showed the best spread. The temporary pools with fresh, clean water gave good spread with the wetting agents or the used crankcase oil. The fuel oil failed to spread well on any pond. Equal parts of Span 20 and Tween 20 gave more satisfactory spreading to fuel oil than did Triton X-100.

When this work was in progress, the failure to secure satisfactory spreading of oils appeared to be a definite limitation to the use of DDT-oil solutions. It was quickly shown, however, that light applications of finely divided sprays from aerosol bombs or hand sprayers gave complete coverage and produced highly satisfactory control of anophelines in similar situations (2, 3). It has since been learned that there are many areas in the tropical and subtropical regions of the world where oils spread poorly at certain seasons. In such areas it would be hazardous to depend upon pouring or squirting the small amounts of oil containing DDT that are needed for controlling mosquito larvae, but dependence could be placed on the use of hand sprayers.

Literature Cited

(1) DEONIER, C. C., BURRELL, R. W., MAPLE, J. D., AND COCHRAN, J. H. 1945. DDT as an anopheline larvicide: Preliminary field studies. Jour. Econ. Ent. 38:244–249.

(2) JONES, H. A., DEONIER, C. C., BURRELL, R. W., AND KNIPLING, E. F. 1945. Larvicidal aerosols containing DDT. Jour. Econ. Ent. 38:432–433.

(3) WISECUP, C. B., BURRELL, R. W., AND DEONIER, C. C. 1945. DDT sprays mechanically dispersed for control of anopheline mosquito larvae. Jour. Econ. Ent. 38:434–436.

COMPARATIVE TESTS WITH DDT AND PHENOTHIAZINE AGAINST TWO AMERICAN [1] AND THREE NEW GUINEA SPECIES [2] OF MOSQUITO LARVAE

R. C. BUSHLAND
U. S. D. A., Agr. Res. Adm., Bureau of Entomology and Plant Quarantine

DDT has been extensively tested since 1942 against various species of mosquito larvae at the Orlando, Fla., laboratory of the Bureau of Entomology and Plant Quarantine. Deonier *et al.* (1945) reported that DDT applied as acetone-water suspensions at 0.01 p.p.m. caused 98.2 per cent mortality of fourth instar larvae of *Anopheles quadrimaculatus* Say, and was more than 100 times as toxic as phenothiazine to this species. Eide *et al.* (1945) found that DDT at 0.05 p.p.m. was lethal to larvae of *Aedes taeniorhynchus* (Wied.), *A. sollicitans* (Walk.), *A. aegypti* (L.), *Psorophora confinnis* (L.-Arr.), *P. ciliata* (F.), and *Culex quinquefasciatus* Say.

Early in 1943 the writer made tests at Orlando with DDT and phenothiazine against larvae of *Aedes aegypti* and *Culex quinquefasciatus*. During 1944 and 1945, while on military duty in New Guinea, he also made laboratory tests with these insecticides against larvae of *Anopheles punctulatus* Donitz, *Armigeres milnensis* Lee, and *C. annulirostris* Skuse. The results of all these tests are reported herein.

Materials and Methods.—The DDT used in these studies was the technical grade purified by recrystallization from ethyl alcohol. The phenothiazine was a pure compound made by chemists of the Division of Insecticide Investigations of this Bureau.

The test procedure was similar to that described by Bushland and King (1943). Freshly made acetone solutions of the insecticides were employed in every test. DDT was dissolved in acetone to make a 1 to 160,000 stock solution; phenothiazine was used at 1 to 4,000. For each test the desired amount of acetone solution was added to 225 ml. of distilled water in a 400 ml. beaker, and thoroughly mixed. Fourth-instar larvae held in 25 ml. of water were then poured into the test beaker. Thus, each test consisted of a number of larvae in 250 ml. of distilled water containing the desired concentration of insecticide. The amount of insecticidal solution added to the water never exceeded 2.5 ml.

Visible precipitates are formed when concentrated acetone solutions of DDT or phenothiazine are added to distilled water. However, at the dilutions used in these studies the water remained clear.

At least one control beaker was used in every series of tests. Earlier work (Fink *et al.* 1938, Bushland and King 1943) had established that 1 per cent of acetone in distilled water was harmless to *Culex quinquefasciatus* and *Aedes aegypti* larvae. Therefore, in tests against these species the control consisted only of larvae in distilled water. The effect of acetone on the New Guinea species of larvae was unknown, however; so there was included in those tests one jar containing acetone in an amount equal to the maximum applied with any insecticide. There was no mortality in any of the acetone-treated controls during a 48-hour observation period.

The number of larvae used per test varied with the abundance of the test species. The maximum number per beaker was 50 in tests with *Culex quinquefasciatus*, and the minimum was 10, with *Anopheles punctulatus*.

[1] Work on American mosquitoes was conducted under a transfer of funds, recommended by the Committee on Medical Research, from the Office of Scientific Research and Development to the Bureau of Entomology and Plant Quarantine.

[2] The New Guinea mosquitoes were identified by W. V. King.

Culex quinquefasciatus and *Aedes aegypti* were reared in 1-gallon battery jars on a diet of ground dog food. *Anopheles punctulatus, Armigeres milnensis,* and *C. annulirostris* were freshly collected in their natural breeding places. For all tests the larvae were held in a wire strainer and gently washed with distilled water. Larvae of uniform size were then counted out into holding beakers containing 25 ml. of distilled water. These beakers were selected at random for testing.

All tests were made at room temperature, which averaged about 26° C. in Florida and about 31° in New Guinea. In Florida the first mortality readings were made after 16 hours and the final readings after 40 hours, as was done in earlier larvicide work (Bushland and King 1943). However, in New Guinea observations were made at intervals of 24 and 48 hours, the intervals used by Deonier *et al.* (1945) in their tests against *Anopheles quadrimaculatus.* All moribund larvae were counted as dead.

Results.—The results of tests against 6 lots of *Culex quinquefasciatus* larvae and 3 lots of *Aedes aegypti* larvae are presented in Table 1. The median lethal concentration of DDT for *Culex quinquefasciatus* was between 1 part in 75 million parts of water and 1 part in 100 million. In the tests against *Aedes aegypti* the lowest concentration of DDT, 1 to 100 million, killed 81 per cent of the insects.

Table 2 shows the results obtained with *Anopheles punctulatus* larvae collected near Oro Bay, New Guinea, and used in one series of tests made in June and a second series in October 1944. Only 10 larvae were available for each test, but the results after 48 hours checked closely. At the 24-hour observation it was difficult to differentiate between moribund larvae and those not so seriously affected. Those observations are therefore omitted and only the 48-hour records are shown.

TABLE 1. Mortality of *Culex quinquefasciatus* and *Aedes aegypti* Larvae Exposed to Various Concentrations of DDT and Phenothiazine, Florida.

Concentration of Insecticide	*Culex quinquefasciatus* [1]		*Aedes aegypti* [2]	
	After 16 Hours	After 40 Hours	After 16 Hours	After 40 Hours
	Per Cent	*Per Cent*	*Per Cent*	*Per Cent*
DDT (1 part in indicated million parts of water):				
16			100	100
20	99.7	100.0	99	100
30	98.3	99.3	85	99
40	92	94	85	93
50	81.3	87.7	73	95
75	70.8 (5 tests)	79.2 (5 tests)	68	87
100	36.3	40.7	55	81
Phenothiazine (1 p.p.m.)	82.3	88	85	92
Control (no treatment)	0	0	0	4

[1] 6 tests, 50 larvae per test.
[2] 3 tests, 25 larvae per test.

Only one series of tests was made (October 1944) against larvae of *Armigeres milnensis.* For each concentration of insecticide 20 larvae were employed, but in computing the mortality (Table 3) those larvae that pupated during the test were not considered. The number of larvae lost through pupation is also shown. The median lethal concentration of DDT against this species appeared to be between 1 part in 50 million parts of water and 1 part in 75 million.

One series of tests was made in January 1945, at Hollandia, Dutch New Guinea, using 25 larvae of *Culex annulirostris* at each concentration. This species seemed unusually susceptible to DDT, as all larvae were killed within 24 hours at

TABLE 2. Mortality of *Anopheles punctulatus* Larvae Exposed to Various Concentrations of DDT and Phenothiazine (10 Larvae per Test). New Guinea.

Concentration of Insecticide	Number of Tests	Mortality After 48 Hours
		Per Cent
DDT (1 part in indicated million parts of water):		
40	1	90
50	2	90
75	1	80
100	2	45
200	2	30
400	1	10
Phenothiazine (p.p.m.):		
1	2	100
0.75	1	90
0.50	2	35
0.25	2	15
0.10	2	0
Controls:		
1% acetone	1	0
No treatment	2	0

TABLE 3. Mortality of *Armigeres milnensis* Larvae Exposed to Various Concentrations of DDT and Phenothiazine. (20 Larvae per Test.) New Guinea

Concentration of Insecticide	Mortality After 24 Hours	Mortality After 48 Hours	Number Pupated in 48 Hours
DDT (1 part in indicated million parts of water	*Per Cent*	*Per Cent*	
16	100	100	0
30	95	100	0
40	5	79	6
50	25	80	3
75	10	36	6
100	5	8	8
Phenothiazine (p.p.m.):			
2.5	65	72	2
2	35	60	0
1.5	20	62	7
1	15	19	4
0.5	0	6	3
Controls:			
1% acetone	0	0	5
No treatment	0	0	0

concentrations of 1 part in 30, 40, 50, 75, 100, and 150 million parts of water. At 1 to 200 million 23 larvae died during the first 24 hours, and after 48 hours the 2 survivors still appeared to be of normal vigor. The results with phenothiazine are shown in Table 4. The larvae seemed to be no more susceptible to this material than were certain lots of *C. quinquefasciatus* tested in earlier work in Florida.

TABLE 4. Mortality of *Culex annulirostris* Exposed to Various Concentrations of Phenothiazine. New Guinea.

Concentration	After 24 Hours	After 48 Hours
	Per Cent	*Per Cent*
(P.p.m.):		
2.0	100	100
1.5	96	96
1.0	92	100
0.50	44	60
0.25	4	16
Controls:		
1% acetone	0	0
No treatment	0	0

Discussion.—It is difficult to ascribe definite minimum and median lethal concentrations for mosquito larvicides, because of the variation in resistance among different lots of the same species. In tests against 56 lots of laboratory-reared larvae of *Culex quinquefasciatus,* Bushland and King (1943) found that 1 p.p.m. of phenothiazine caused a mean mortality of 69.1 ± 2.08 per cent, with kills for the various lots ranging from 40 to 100 per cent. Therefore, it seemed desirable to compare DDT with phenothiazine. The results reported in this paper show that the lots of *quinquefasciatus* larvae used were somewhat more susceptible to phenothiazine than the average, and that a DDT concentration of 1 part in 20 million parts of water might allow some survivors if further tests were made. Against this species DDT appeared to be about 50 times as effective as phenothiazine.

Tests against *Aedes aegypti* were too few to establish lethal concentrations for the species, but DDT again appeared to be about 50 times as toxic as phenothiazine.

The results of tests with *Anopheles punctulatus* are of special interest because of the importance of that species as a vector of malaria in the southwest Pacific. Field-collected larvae brought into the unnatural conditions of laboratory testing should be easier to kill than laboratory-reared *quadrimaculatus* from an established colony. However, *punctulatus* seemed much more resistant to DDT than the *quadrimaculatus* tested by Deonier *et al.* (1945). A DDT concentration of 1 to 100 million, which gave nearly 100 per cent mortality of *quadrimaculatus,* caused only 45 per cent mortality of *punctulatus.* The highest concentration tested (1 to 40 million) failed to kill all the *punctulatus* larvae. The *punctulatus* larvae used in these tests were not extremely resistant to all insecticides, because phenothiazine at 1 p.p.m. was 100 per cent lethal, whereas the same treatment killed only 79 per cent of the *quadrimaculatus* larvae.

Armigeres milnensis larvae were very resistant to phenothiazine. This compound caused only 72 per cent mortality at 2.5 p.p.m., a concentration which in earlier work the author found to be lethal to larvae of *Aedes aegypti, A. taeniorhynchus, A. mitchellae* (Dyar), *Psorophora confinnis, Culex nigripalpus,* Theob., and *C. quinquefasciatus.* However, *Armigeres milnensis* seemed to be about as susceptible to DDT as were *C. quinquefasciatus* and *A. aegypti,* since a treatment of 1 part in 30 million killed all the larvae. DDT appeared to be about 100 times as toxic as phenothiazine to *Armigeres milnensis.*

In the tests against *Culex annulirostris* it was pointed out that this species was very susceptible to DDT, a concentration of 1 to 150 million being lethal. The particular groups of larvae tested were about as susceptible to phenothiazine as the least resistant group of *Culex quinquefasciatus.* The results indicated that DDT was about 150 times as toxic as phenothiazine to this species.

Summary.—DDT and phenothiazine were tested against fourth-instar larvae of two American and three New Guinea species of mosquitoes according to a standard laboratory procedure for evaluating organic insecticides.

DDT caused 100 per cent mortality of *Culex quinquefasciatus* Say and *Aedes aegypti* (L.) larvae at 1 part in 20 million parts of distilled water, and appeared to be about 50 times as toxic as phenothiazine to these species. The median lethal concentration for *C. quinquefasciatus* was between 1 to 75 million and 1 to 100 million. Against *A. aegypti* the lowest concentration tested, 1 to 100 million, killed 81 per cent of the test insects.

DDT caused 90 per cent mortality of *Anopheles punctulatus* Donitz at the two highest concentrations tested, 1 to 40 million and 1 to 50 million. The median lethal concentration appeared to be near 1 to 100 million. DDT was indicated to be about 70 times as toxic as phenothiazine to this species.

DDT was lethal to *Armigeres milnensis* Lee at a concentration of 1 to 30 million and the median lethal concentration appeared to be between 1 to 50 million and 1 to 75 million. DDT appeared to be about 50 times as toxic as phenothiazine to this species.

DDT was lethal to *Culex annulirostris* Skuse at a concentration of 1 to 150 million. The lowest concentration tested, 1 to 200 million, caused 92 per cent mortality. DDT appeared to be about 150 times as toxic as phenothiazine to this species.

Literature Cited

BUSHLAND, R. C., AND W. V. KING. 1943. Laboratory tests with organic compounds as larvicides for *Culex quinquefasciatus* Say. U. S. Bur. Ent. and Plant Quar. E-585, 15 pp. (Processed.)

DEONIER, C. C., J. D. MAPLE, H. A. JONES, E. HINCHEY, AND P. M. EIDE. 1945. DDT as an anopheline larvicide—Laboratory tests. Jour. Econ. Ent. 38(2):241–3.

EIDE, P. M., C. C. DEONIER, AND R. W. BURRELL. 1945. DDT as a culicine larvicide. Jour. Econ. Ent. 38(5):537–41.

FINK, D. E., L. E. SMITH, D. L. VIVIAN, AND H. V. CLABORN. 1938. Toxicity tests with synthetic organic compounds against culicine mosquito larvae. U. S. Bur. Ent. and Plant Quar. E-425, 34 pp. (Processed.)

EDITOR'S NOTE:

MOSQUITO NEWS is happy to publish in its entirety the script of a radio talk by Professor Victor K. LaMer of Columbia University on the subject "Insect Control with DDT." This script deals with aerosols and their practical use in mosquito control. Some of the fundamental work in this field of aerosols is here presented in nontechnical language by one of the world's leading authorities on the subject.

"INSECT CONTROL WITH DDT"

Script of radio talk by Professor Victor K. LaMer of Columbia University over Station WNYC, New York City, on January 30, 1947, presented as a joint public service of the American Chemical Society News Service and Station WNYC.

ANNOUNCER: In co-operation with the American Chemical Society, we now bring you an interview with Professor Victor K. LaMer of Columbia University. Professor LaMer's topic will be "Insect Control With DDT." He will be interviewed by George Boehm of the American Chemical Society News Service.

MR. BOEHM: We are told that insects are man's most deadly enemies in his struggle to dominate the earth. In fact, it has been said that insects will eventually take over, unless man takes adequate steps to control them. Despite our much-heralded programs of insect control, such pests as the bean beetle and Hessian fly destroy at least 10 per cent of the food crop in the United States—that is two billion dollars' worth of food. Mosquitoes, ticks, and others spread deadly diseases among man and his domestic animals. Would you say, Professor LaMer, that DDT and the other powerful new insecticides are the weapons that will enable man to conquer his insect foes?

PROF. LAMER: Yes, Mr. Boehm, DDT and its cousins should solve many of our problems of insect control, but only if they are used wisely. Much careful study is needed to find out just how each insecticide can best be used to control each species of insect pest.

MR. BOEHM: During the war, Professor LaMer, you helped solve the problem of controlling mosquitoes with DDT. Your work led to control of the dreaded anopheline mosquito in the South Pacific, where early in the war malaria spread by that insect was causing more casualties among our troops than bombs and bullets combined. Could you tell us how you went about your work, and give us a rough idea of what you discovered?

PROF. LAMER: I would be glad to. The Department of Agriculture made an important contribution to insect control by developing the so-called freon-insecticide "bomb," which is about the size of a milk bottle. When the valve is opened, a fine spray of insecticide is released. It is effective within a room but carries only a few feet outdoors. A way of treating large areas with insecticides was urgently needed. The Department of Agriculture turned for help to the National Defense Research Committee, which then assigned the problem to our staff at the Central Aerosol Laboratories of Columbia University.

MR. BOEHM: Isn't an aerosol simply a fog made up of droplets so small that they float in the air, Professor LaMer?

PROF. LAMER: That's right, Mr. Boehm. We planned to generate fogs of oil, in which DDT had been dissolved. We hoped that these aerosol fogs would roll over the ground for long distances, killing all mosquitoes in their path.

MR. BOEHM: Why didn't you use ordinary mechanical sprayers?

PROF. LAMER: Mechanical sprayers had already been tried and found ineffective

for long distances. You see, the large droplets in the spray quickly fell to the ground where they had little chance of doing harm to mosquitoes. With aerosols we hoped to hit the mosquitoes on the wing.

MR. BOEHM: Did you find that the size of the aerosol droplets was important, Professor LaMer?

PROF. LAMER: It certainly was, Mr. Boehm. A theoretical study of particles floating in air and laboratory experiments on fruit flies and mosquitoes indicated that best results could be expected if all the aerosol droplets were about ten microns in diameter, that is, about four ten-thousandths of an inch. Fortunately, we already knew how to regulate the size of aerosol droplets.

MR. BOEHM: Just why was ten microns the best size?

PROF. LAMER: If the droplets were much larger, like spray droplets, they would fall to the ground too quickly. On the other hand, if they were too small, they would be caught in the tiny air currents that surround each mosquito, and would flow around the insect without depositing on it. The mosquito would be protected by its streamlined figure. To do its work, the aerosol droplet containing DDT must actually be deposited upon the insect's body.

MR. BOEHM: Did you check your calculations with large-scale outdoor experiments?

PROF. LAMER: Yes, in co-operation with the Department of Agriculture we did extensive field testing at Cocoa, Florida, on the salt marsh mosquito and in the T.V.A. territory on the malaria-carrying anopheline mosquito. We soon found that in the hot sunshine, the aerosol fog quickly swirled upward from the ground and was no more effective than the sprays. But at night or on cloudy days the fog hugged the ground and killed virtually all mosquitoes for a mile downwind.

MR. BOEHM: Wasn't this an expensive way to distribute DDT, Professor LaMer?

PROF. LAMER: Not at all, Mr. Boehm. We found that we needed only about a tenth of a pound of DDT to rid an acre of open country of all mosquito life, and even less for the larvae which breed in stagnant pools. In forest areas, about twice as much aerosol is necessary, because some is deposited on the trunks, leaves, and branches of the trees. In the case of the mechanical sprayer, a great deal of the insecticide is filtered out by deposition on the leaves.

MR. BOEHM: Was the aerosol effective on mosquitoes hiding in long grass?

PROF. LAMER: Yes. In fact we found that it followed small eddy currents in the air and penetrated into such hiding places as hollow logs and even in cracks in the bark of trees. We made sure of its penetrating power by placing cages of live mosquitoes in holes in the trees in the path of the drifting fog. Practically all the caged mosquitoes were killed.

MR. BOEHM: For how long is such an aerosol treatment effective, Professor LaMer?

PROF. LAMER: That depends, Mr. Boehm, upon how wide an area is treated. We found that salt marsh mosquitoes migrate twice a day. In the early evening, they leave the swamps and woods and wander toward open places. At dawn they return to the swamps and woods where they find shelter from the sun. The anopheline mosquito, the malaria carrier, fortunately travels less than his salt marsh cousin and is more easily controlled. Due to their migrating habits, it is almost impossible to rid an area of mosquitoes permanently, for they continue to blow in from neighboring breeding areas.

MR. BOEHM: Wouldn't this migrating habit make it especially important to attack the mosquito at its source, the pools in which the larvae breed?

PROF. LAMER: Yes, and the aerosol takes care of the larvae too. Some of the droplets are deposited on the surface of every pool. The larvae, as they swim around, pick up more and more droplets on their bodies, until finally they have collected a fatal dose of DDT.

MR. BOEHM: Does DDT injure fish?

PROF. LAMER: Yes, it can. But we are certain that the concentration of DDT that we recommend for kill-on-the-wing or larva control will not harm fish. Indiscriminate use of DDT or other insecticides will kill fish, as well as birds, bees, spiders, and other small animals.

MR. BOEHM: What effect does wind have on aerosol distribution, Professor LaMer?

PROF. LAMER: In our work we found that wind speed had considerable effect. The aerosol spread more widely when a gentle breeze was blowing, and also it seemed that we might be able to use larger droplets if there was enough wind to carry them. This problem seemed so important, that we returned to the laboratory where we could have our wind made to order.

MR. BOEHM: That sounds interesting, Professor LaMer, could you give us the details?

PROF. LAMER: To the scientist, Mr. Boehm, this phase of our work was the most interesting. At Beltsville, Maryland, the staff of the Central Aerosol Laboratories of Columbia University worked hand-in-hand with scientists of the Department of Agriculture's Bureau of Entomology and Plant Quarantine. To supply the wind, they built a wind tunnel.

MR. BOEHM: Was it like the wind tunnels used for testing airplane models?

PROF. LAMER: Yes, it worked on the same principle. It was a narrow tunnel, thirty-two feet long. At one end a fan sucked air through the tunnel. At the other end was an aerosol generator which produced droplets all of the same size. A door was cut in the middle of the tunnel so that we could insert wire cages of live mosquitoes, and glass panes around that section let us observe what went on inside the cages.

MR. BOEHM: You could regulate both the speed of the wind and the size of the aerosol droplets?

PROF. LAMER: On different cages of mosquitoes we varied the wind from two to sixteen miles an hour. We tried droplet sizes from one to twenty microns diameter, that is, about four hundred-thousandths of an inch to about a thousandth of an inch. Our figures showed that the effectiveness of the DDT aerosol depended jointly upon the wind speed and the volume of the droplets, as long as the droplets were small enough to be carried by the wind.

MR. BOEHM: In other words, by doubling the particle volume or wind speed, you could approximately double the effectiveness of the aerosol. Did you also find out how much DDT is a fatal dose for a single mosquito?

PROF. LAMER: Theoretically, only one fifteen-billionth of a pound of DDT is needed to kill the average healthy female mosquito. The males are even more vulnerable. DDT, however, does not do its work immediately. Many mosquitoes carry a fatal dose on their bodies for several hours before they die.

MR. BOEHM: It would seem, Professor LaMer, that your laboratory technique could be adapted to the problem of controlling almost any insect with almost any insecticide.

PROF. LAMER: Yes, Mr. Boehm, we hope that we have supplied a model for future studies of insect control. Different insects and different insecticides will call for different doses. But the aerosol, or fog, method of distributing the poison should work well in many cases. We hope that our general conclusions about the effect of windspeed and droplet size will in all cases hold true. At any rate, we have determined

the fundamental laws by which aerosol particles are deposited on insects.

MR. BOEHM: Do you think that with aerosols we will be able to control grasshoppers, locusts, gnats, black flies, and hundreds of other insects that plague us?

PROF. LAMER: Undoubtedly, most of them will succumb to the aerosol treatment. But once again, let me emphasize, powerful insecticides can work against us as well as for us, if we do not use them wisely. For example, DDT has been dumped from airplanes in large quantities. While it is true that this procedure rids an area of mosquitoes for a long time, the high concentration kills fish and birds, man's natural allies in his war on insects. The kill-on-the-wing aerosol method, which we have described, requires just enough DDT to kill the mosquitoes and cannot harm our allies. In other words, our aerosol method is as selective in its action as a well-aimed rifle bullet.

MR. BOEHM: Thank you, Professor LaMer.

ANNOUNCER: You have just heard an interview with Professor Victor K. LaMer of Columbia University. This program has been brought to you with the cooperation of the American Chemical Society. If you would like a copy of Professor LaMer's talk, you may obtain one by sending your name and address in a letter or on a postcard to the American Chemical Society News Service, the Lincoln Building, New York City. I repeat. The American Chemical Society News Service, the Lincoln Building, or to the station to which you are now listening.

ADVERTISING RATES

FOR

Mosquito News

	1 issue	4 issues
Full-Page	**$40.00**	**$144.00**
Half-Page	**$24.00**	**$86.40**
Quarter-Page	**$16.00**	**$57.60**

Preferential Positions — $5.00 an issue extra

1. Facing Front Cover **2. Facing First Article**

3. Facing Back Cover

For Information Write

C. S. MACFARLAND, Jr.

Advertising Manager,

289 Fourth Ave., N. Y. 10, N. Y.

ASSOCIATION NEWS

REPORT OF THE MAY 24–25, 1946 MEETING, Continued

With President-elect Stage absent because of the railway strike and with President Ruth presiding, as stated in an earlier number of MOSQUITO NEWS, the program was started by President Ruth with the announcement that since Dr. Bishopp and Dr. Ginsberg (both on the morning program) were likewise absent, the entire morning session would be available for discussion of the remaining item on the morning program, namely, *The Significance of Particle Size in Sprays and in Aerosol Fogs,* and that the subject would be opened with a paper read by Dr. R. D. Glasgow, who would then lead the discussion.

Dr. Glasgow spoke informally, substantially as indicated in the manuscript submitted.

THE SIGNIFICANCE OF PARTICLE SIZE IN SPRAYS AND IN AEROSOL FOGS [1]

R. D. GLASGOW
State Entomologist, New York State Science Service, Albany

Many insect pests, including mosquitoes, many fungus diseases of crop plants and of fruits, and even weeds of many kinds may be suppressed by introducing into their environment some poison or other factor that in one way or another may prevent their normal activities.

Such poisons are usually applied either dry in the form of dusts, in liquid form as sprays or mists or fogs, or as a gas; the dusts being more or less finely pulverized solids, the gaseous poisons in general being limited to use in closely sealed enclosures, and the liquid sprays or mists or fogs being distinguished, as the names indicate, by the range of droplet diameters characteristic of each.

CONTRIBUTIONS FROM THE STUDY OF "SMOKES" FOR WAR USE

While the greater effectiveness of more finely dispersed insecticide and fungicide dusts and sprays was recognized even before the recent war, our understanding of the behavior of small particles, and the development of improved mechanisms for their production and use have been tremendously advanced through special studies prompted by war needs.

[1] Many of the data given are adapted from "Clouds and Smokes" by W. E. Gibbs, and from the "Handbook of Chemistry and Physics," edited by Charles D. Hodgman.

Under war compulsion, much money and scientific effort were expended upon intensive studies of minute particles dispersed in air, and of means for the production of aerosol fogs.

These studies had various objectives. One objective, for example, was better knowledge concerning the production and behavior of, and possible defense against minute particles or "smokes" of special chemicals which would pass unchecked through the canister of a gas mask, and by producing tears or inducing a paroxysm of violent sneezing, would force the wearer to remove his mask and thus become exposed to an accompanying poison gas. An even more immediately important objective was the development of new and better, and more abundantly available sources of screening "smokes" for use especially in battle to conceal the movement of troops or of ships.

Since the dawn of history, screening smokes have been used for concealment in warfare. According to early records smoke from smudge pots, or even from incendiary conflagrations was commonly used. During the first world war, chemical "smokes" similar to those employed by sky-writers were tried. During the second world war, however, screening smokes were required in such huge

quantities that neither suitable fuel, nor any appropriate chemical was available in sufficient quantity to produce them.

Early in the last war, therefore, intensive scientific study of the problem resulted in the development of several more or less similar thermal dispersion mechanisms which could produce a fog of minute oil droplets, the diameter of which (about 2/3 of a micron) was such as to give maximum dispersion of light rays in the visible spectrum, and thus provide maximum concealment.

A solid reduced to minute particles may be dispersed in air as a dust or smoke, and if insoluble may be dispersed in a liquid as a suspension. A liquid reduced to minute droplets may be dispersed in an immiscible liquid medium as an emulsion; or if relatively non-volatile, may be dispersed in air as a spray, or mist, or fog. Such a mixture of one substance suspended in another as very small particles is called a disperse system.

Within technically prescribed limits of particle size, but employed more loosely in popular discussion, where water is the dispersion medium, the disperse system is known as a *hydrosol;* and where air is the dispersion medium, the disperse system is known as an *aerosol.*

The properties and performance of such disperse systems present a very large field for study and discussion: entirely too large a field to be covered adequately in the time at our disposal this morning.

Accordingly, we shall limit our discussion, today, to some of the properties of oil droplets dispersed in air, since this phase of the larger subject appears at present to be of special interest to mosquito control workers.

Adaptation of the Thermal-Aerosol Fog to the Dispersion of Insecticides

With the appearance of the new oil-fog "smoke" generators on the battlefield in areas where mosquitoes and mosquito borne diseases were an important military problem, the question was raised why the new and powerful insecticide DDT could not be dissovled in the fog oil, and the new mechanisms given a multiple service value.

This was tried locally with encouraging success; but because the high temperature employed to vaporize the fog oil was supposed to decompose and inactivate a very considerable percentage of the DDT, and because the military screening smokes produced by these early machines would rise too high, drift too far, and deposit too sparingly for effective insect control use, further studies were started in various quarters, designed to work out more fully the properties and performance of disperse systems of the thermal aerosol fog type, and to modify the earlier military, thermal "smoke" generators, so they could be operated at lower temperatures, to produce aerosol fogs of various, and controllable droplet diameters.

The Unit of Measure Empolyed in the Discussion of Droplet Diameters

Spray droplets, and especially the droplets of aerosol mists and fogs may be so extremely small that we must have a very small unit of measurement with which conveniently to express their diameters. Our American system of feet and inches does not provide any such conveniently usable small units of measurement. It is customary then, when discussing such small objects, to turn to the metric system of measurement, and to express the diameters, as of spray and fog droplets, in microns.

What is a Micron? (Since some of our members may not be accustomed to think in terms of metric units of measurement.)

1. A *meter* is a little more than one yard, or 39.37 inches, to be exact.
2. A *millimeter,* as the implies, is one one-thousandth (1/1000) of a meter, or about one twenty-five thousandth an inch.
3. A *micron* is one one-thousandth (1/1000) of a millimeter; one one-millionth (1/1,000,000) of a meter, or about one twenty-five thousandth (1/25,000) of an inch.

WHY IS PARTICLE SIZE SIGNIFICANT IN INSECTICIDE SPRAYS, MISTS, AND FOGS?

At the same temperature and pressure, the reactivity of a chemical, or the effectiveness of an insecticide or fungicide, increases with an increase of exposed surface; and for droplets of different diameters, the volumes are to each other as the cubes of the diameters (or "as the cubes of like dimensions") while the surfaces are to each other as the squares of the diameters.

So, for equal volumes of an oil dispersed as spray or fog, with one volume dispersed as droplets 50 microns in diameter, and an equal volume dispersed as droplets 5 microns in diameter, the diameter of the larger droplets being 10 times that of the smaller, there would be 10 times 10 times 10, or 1000 times as many of the smaller droplets, with the total surface area of the smaller droplets 10 times 10, or 100 times as great as the total surface area of the larger droplets.

Not only this, but the reactivity or effectiveness increases further with an increase in the convexity of the exposed surface; and, obviously, the surface of the droplets rapidly becomes more sharply convex, as the diameter becomes smaller and smaller.

For example: One gram (approximately one thirtieth of an ounce, or a little less than a quarter of a teaspoonful) of water falling as the large drops of a heavy rain would represent about 30 drops, each 4 millimeters or 4000 microns in diameter, and the total surface area of the 30 drops would be about 15 square centimeters; or a total surface area about equal to one side of 3 ordinary postage stamps.

As a fine drizzle, the same one gram of water would make thirty thousand droplets each 0.4 of a millimeter or 400 microns in diameter, with a total surface area of 1,500 square centimeters.

In the form of a mist, the same one gram of water would make thirty million droplets each 0.04 of a millimeter or 40 microns in diameter, with a total surface area of 150,000 square centimeters.

Again, in the form of a fog, the same 1 gram of water would make thirty billion droplets each 0.004 of a millimeter or 4 microns in diameter, with a total surface area of 15,000,000 square centimeters, or a total surface area about equal to the combined area of two average city lots, each 60x120 feet.

And finally, in the form of a cloud, the same 1 gram of water would make thirty trillion droplets each 0.0004 of a millimeter or 0.4 of a micron in diameter, with a total surface area of 1,500,000,000 square centimeters, or a total surface area of 37 acres; equivalent to an area almost a quarter of a mile square.

It may be helpful now to translate these, or similar figures into terms of distribution per unit area, for an insecticide solution applied as spray or fog.

For application from the air, some operators have come to the conclusion that 2 quarts per acre represents a practical balance between pay-load and coverage, with the concentration adjusted to give the desired quantity of insecticide per unit area.

Mechanical sprays vary widely in particle size, depending upon the pressure,

RECAPITULATION. Relation of Droplet Diameter to Number of Droplets, and to Total Surface Area.

Quantity of Water	Type Dispersion	Diameter of Droplets		Number of Droplets	Total Surface Area of Droplets
		Millimeters	Microns		
1 gram	Rain	4.0	4000	30	15 sq. cm. (3 postage stamps)
1 gram	Drizzle	0.4	400	30 thousand	1,500 sq. cm. (12 in. x 17 in.)
1 gram	Mist	0.04	40	30 million	150,000 sq. cm. (10 ft. x 14 ft.)
1 gram	Fog	0.004	4	30 billion	15,000,000 sq. cm. (2 city lots)
1 gram	Cloud	0.0004	0.4	30 trillion	1,500,000,000 sq. cm. (37 acres)

and the type of nozzle used; the droplets ranging from something like 40 or 50 microns to about 150 microns in diameter, and having an average droplet diameter for the sprays usually employed probably in the neighborhood of 100 microns.

At 2 quarts per acre:

1. With droplets 100 microns (1/250 inch) in diameter, there would be approximately 1 droplet for each square millimeter of horizontal surface.

2. With droplets 10 microns in diameter, these would be approximately 1,000 droplets for each square millimeter of horizontal surface.

3. With droplets 1 micron in diameter, there would be 1,000,000 droplets for each square millimeter of horizontal surface.

Even where the leaf surface of covering vegetation may have greatly increased the total "acreage" beyond that of the "horizontal surface", this enormously multiplied number of droplets together with their slower settling through constantly eddying air, should help to assure adequate coverage.

These data on dispersion are given special significance by our new high power insecticides, such as DDT. Why, then, should we look further? Why not use DDT in the finest aerosol fogs, and consider our pest control problems solved?

Why not? Because some of the physical factors which govern the behavior of individual particles in a disperse system, such as the air suspended droplets of an aerosol oil fog, present very definitely limiting conditions.

SOME LIMITING FACTORS

It is convenient to distinguish three kinds of aerosols:

1. DUSTS OR MISTS, in which the particles are larger than 10 microns in diameter. Such particles settle in still air with increasing velocity. *They do not diffuse,* or tend, as does a gas, to escape through crevices in an enclosure.

2. CLOUDS OR FOGS, in which the particles range in diameter from 10 microns to 0.1 micron. Such particles settle in still air at a constant velocity which varies with the diameter of the particle. *They, also, do not diffuse.*

3. SMOKES, the particles of which range from 0.1 micron to 0.01 micron. Such particles are small enough to be pushed about by the impact of surrounding air molecules (which are in constant motion at average velocities of about a quarter of a mile per second), and show the resulting "Brownian movement". They settle very, very slowly, or not at all in still air; and, varying with particle diameter, or with mass and associated Brownian activity, *they diffuse more or less rapidly;* though never as rapidly as do the molecules of a gas.

Any particle suspended in a gas (as in air) is subject to two sets of forces:

1. It is pulled downward by *gravity.*
2. Its downward fall is *resisted* by the viscosity of the gas.

In general, for particles larger than 10 microns diameter, *Gravity* is greater than *Resistance* at all velocities, and the particle settles with constantly increasing velocity.

For particles smaller than 10 microns diameter, *Resistance* increases as the velocity of the particle increases until *Resistance* becomes equal to *Gravity,* and the particle then continues to fall at a constant velocity.

RATE OF FALL IN STILL AIR FOR DROPLETS OF DIFFERENT DIAMETERS

Diameter of Particle	Rate of Fall per Second (About)	Time to Fall One Foot (About)	Time to Fall from 10 Foot Ceiling to Floor (About)
100 microns	30 centimeters or 12 inches	1 foot in 1 second	10 ft. in 10 seconds
10 microns	3 millimeters or 1/8 inch	1 foot in 1⅔ min.	10 ft. in 16⅔ min.
1 micron	30 microns or 1/800 inch	1 foot in 2¾ hours	10 ft. in 27½ hours
0.1 micron	0.3 microns or 1/80,000 inch	1 foot in 11½ days	10 ft. in 115 days

From this table it is clear that different pest control problems may be most effectually served only by aerosol fogs of appropriate mass-average and range of droplet diameters.

For indoor pest control operations, aerosol fogs of very small droplet diameter that will remain for many hours suspended in the air, will eddy with convection currents most effectually into spots that are difficult to reach.

For outdoor use, spray or fogs of larger droplet diameter must be used to avoid wasteful transportation by winds beyond the limits of set objectives, and to assure effectual deposit of the insecticide.

Neither standard mechanical spray outfits delivering mists of 100 micron average droplet diameters or smaller, nor thermal aerosol fog generators, drive the mist or fog any great distance from the nozzle. Indoors, convection currents and associated eddy currents will rapidly carry a fine aerosol fog throughoutout all parts of an enclosed space. Outdoors, however, aerosol fogs must depend for much of their unique effectiveness on horizontal transportation by wind. Here, again, we encounter a very signficant scale of values.

A four mile per hour wind is little more than a gentle breeze; but let us see how far droplets of different diameters starting at an elevation of four feet will be carried on a four mile wind before they settle to the ground (four feet being an average height for the nozzle of a fog generator).

These mushrooming figures which so rapidly assume proportions that sound astronomical, serve merely to illustrate the basic complexity of the problems associated with the investigation of aerosol fogs, and with their adaptation to practical use.

Actually, four mile winds never blow continuously for thousands, or even scores of miles; and air, even indoors, is rarely so still that the droplets of sprays or fogs may settle evenly downward.

On the contrary, both indoors and outdoors, convection currents, eddy currents and the like, complicate the pattern tremendously; and introduce special problems that must be taken seriously into account in any discussion of particle size.

Not the least of these special problems are those associated with the deposition of wind-borne aerosol fog droplets on objects in their path.

Here Dr. Glasgow paused in his comments on particle size to open the discussion (see page 27). After a few comments at the conclusion of the discussion (see page 29), he resumed:

The wind-borne droplets of an insecticide aerosol fog may be considered as minute, death dealing projectiles moving substantially in parallel horizontal lines; for with a highly potent insecticide like DDT, even extremely small droplets may be made each to carry a killing dose of the poison.

A wind blowing toward a stationary object tends to hold against the side of the object which faces the wind a cushion of dead air that divides the approaching wind current and diverts it to right and left. A similar relation is set up by an object, such as an insect, moving in still air.

Wind borne aerosol fog droplets, theoretically, may move in horizontal straight lines in open spaces; but they tend to follow the resulting curved flow lines, as the passing wind is deflected to the right or left of obstacles encountered in its course.

For the same quantity of material dis-

DROPLET DIAMETER, RATE OF FALL IN STILL AIR, AND DISTANCE CARRIED

Droplet Diameter	Rate of Fall per Second (About)	Time to Fall 1 Foot (About)	Distance Carried While Settling 1 Foot (About)
100 microns	1 foot	1 foot in 1 second	23–7/15 feet
10 microns	1/8 inch	1 foot in 1⅔ min.	2346–2/3 feet
1 micron	30 microns	1 foot in 2¾ hours	44 miles
0.1 micron	0.3 micron	1 foot in 11½ days	4404 miles

persed as an aerosol fog, when used indoors, or when used for flying insects out of doors, droplets of small diameter will give a closer and more effective barrage; just as the same weight of metal in the form of machine gun fire will stop advancing enemy troops more effectually than it would in the form of large calibre solid shot.

On the other hand, to continue the simile, for wind-borne large scale coverage of vegetation and the like, where we must break through a barrier cushion of still air, we are obliged, artillery like, to choose aerosol fogs of larger droplet diameter in order that the greater momentum of the heavier particles, by holding a straighter course, may more effectually smash through the obstructing cushion of dead air, and actually deposit the insecticide where needed.

In general, a broader object will be shielded by a correspondingly deeper cushion of dead air; with the result that in a wind borne aerosol fog a hair, or the leg or antenna of a mosquito for example, may receive a greater number of direct hits than would a lead pencil.

Furthermore, more droplets will be deposited near the margin, than at the center of an object; and, by contrast with the shielding cushion of dead air facing the approaching wind, there will be a zone of turbulence immediately behind the object with an even greater deposit of droplets on its back.

THE QUESTION OF RESIDUAL DEPOSIT

It is true that with some insoluble and nonvolatile insecticides such as DDT, lead arsenate, cryolite, and the like, there are places where their use for prolonged or "residual" effect is important. Such use usually means a relatively heavy deposit in places where the insect to be controlled will be likely at some later time to come into effectual contact with the poison. The residual effectiveness of the arsenicals and other stomach poisons has long been known and used. DDT has special interest for such use, because of its prolonged effectiveness under suitable conditions as a residual contact insecticide.

For example, an adequately prolonged, residual, indoor mosquito control operation would require a deposit of something like 200 milligrams of actual DDT per square foot of ceiling and wall surface. This would be at the rate of about 17½ pounds of DDT per acre.

One gram, or roughly 30 four-millimeter drops of a 20% solution would be required to carry 200 milligrams of DDT. Applied as a mechanical spray of 100 micron droplets, there would be about 20 droplets for each square millimetre of the surface to be covered. Of a 5% solution, there would be about 80 droplets for each square millimetre.

As a driving spray, the relatively heavy, 100 micron diameter droplets would easily smash through the barrier cushion of still air, and come to rest as a deposit on the wall surface behind.

It would obviously be very difficult, if not wholly impracticable to build up such a heavy deposit by means of an aerosol fog; although surprisingly persistent residual effects have been observed where aerosol fogs of larger droplet diameter have been used with more highly concentrated formulas.

DISCUSSION

DR. GLASGOW: Before continuing further, I think we should take time out to give an opportunity for discussion.

But, first, we are fortunate to have with us this morning a man who has been doing some particularly outstanding research work, not only on the practical use of aerosol fogs in the field, but notably also, on fundamental studies of some of the special problems just mentioned. I refer especially to the wind tunnel studies of aerosol fogs that have been carried on at Beltsville, Maryland, by Mr. R. K. Latta, of the United States Bureau of Entomology and Plant Quarantine.

I know we shall all be glad to hear Mr. Latta tell us something of the work that he has been doing; and, later, I am sure that he will be glad to answer any questions about his work that we may care to ask him.

MR. LATTA: (From stenographer's report of the meeting.) We have been involved in this study of particle size at the Beltsville Laboratory for about a year and a half or two years, and

have gathered together all of the information that we could from various sources. We have also carried on experiments in the field and in the laboratory, the latter including studies of the deposition of aerosol droplets in a wind tunnel on objects of different kinds. Insects as well as other miscellaneous objects were exposed to aerosol fogs passing through the wind tunnel at various velocities. Variously coated glass slides were exposed in order to study how the droplets are deposited.

One suggestion I might have is on the preparation of slides. We have used the zinc stearate coating on slides, but we found that we have quite a few failures. We tried to follow the problem of coating slides to get a coating material that would be easier to use. We have two that we use now. One is to take one of the spreading agents that you can buy on the market—NNO. Wash the slide, dip it in a one-tenth per cent solution in alcohol. Let dry, and polish. With that slide we have very few failures. We found that we can make slides in this manner in quantity much faster than with zinc stearate. We use this method in preference to one of the silicones produced by the General Electric Company, called "Dry Film."

For study, the slide bearing a deposit of droplets is placed under a microscope and projected on a screen that is cross hatched. Two persons sitting in front of the screen can then count and measure large numbers of particles very rapidly.

MR. SAMMIS: In view of the fact that mosquito control operators are mainly interested in getting a coating on the vegetation, is there any difference between the coating on specially prepared slides, and that on various types of vegetation? Are the values comparable?

MR. LATTA: No. At Beltsville right now we are making special studies of the deposition of aerosols. It is dependent upon the shape of the object upon which the deposition is made, and upon the size of the particle. And not only on the shape of the object, but also upon the size. The way it runs, the smaller and more curved the object, the better the deposition of aerosol particles. Grass, or pine needles, or any foliage of that character, will collect a good quantity of the aerosol as it goes by.

With a drifting aerosol cloud, for each type of object that is interposed in its path, there is a calculable amount of deposit.

The smaller the particle, the more tendency it has to drift around the object. As you increase the size of the particles, a larger and larger number will strike the same type of object in their path. When they strike, we assume that deposition has occurred.

This is also associated with the speed of the particles.

All of these factors taken together will give you some idea of your deposition pattern.

There are two causes of deposition. One is the drifting particle striking an object in its path. The other is the settling factor as the particles fall closer and closer to ground. In the first case, whether the particle in horizontal movement strikes an object in its path, is related to the size of the particle, and the speed at which it is moving. In the second case, the particles may settle on a flat surface.

MR. NELSON: Are there any measurements on the electrostatic charge on the leaf surface, in relation to the particle itself?

MR. LATTA: We do not believe that electrostatic charges enter into the picture. That is the story that is accepted on dust particles, but we haven't seen any evidence on liquid particles. We have been studying the action of aerosols in a wind tunnel. We can duplicate our tests all the time, and pay no attention to these electrostatic conditions. If they were a factor, they would certainly upset the work that we are doing.

MR. DORER: (Did not get question.) (Probably, How much residual deposit does the aerosol leave? Editor's note.)

MR. LATTA: You are asking a question we know no answer to yet. We are trying to learn all about aerosols that we can. We know that aerosol is the best method of striking insects. We know that the deposition on insects from small particles is much greater than it is on foliage. We are studying the factor of deposition because it is very important in many ways, and we are finding that there is a considerable amount of deposition, and that it is a pattern which is concerned with two definite facts. You can contact the insect with the insecticide and in that the finer the particle the better chance you have.

There is some effect from the deposit that is left. It is there. We don't know how much, but we are trying to find out what sort of a deposition you get from an aerosol. You have a gradation of deposition as you go down in particle size. Eventually, particle size is so small that the deposition is practically nil; but there will be some fraction of a per cent. So far, we have considered that an aerosol is our principal means of killing insects by direct contact; and we are finding that there is not enough residual deposition left to be effective.

QUESTION: Have you tested the pyrethrum insecticides in aerosol?

MR. LATTA: No, we have not reached that point yet. Our work has been restricted to fundamental studies of aerosols. There is no reason why pyrethrum aerosol cannot be made. The heat that is developed by the thermal generators looks very high when you read the thermometer; but at the same time contact is almost instantaneous, and to break down the insecticide takes time. In our early work, the first test

we made used an army screening smoke generator and added DDT to the fog oil. Temperatures ran from 900° to 1000° F. We tried pyrethrum in that generator, but our results were not too good. With the newer type generators we have now, pyrethrum and nicotine have been used.

QUESTION: In using a solution, are we to assume that each droplet contains a percentage of the element?

MR. LATTA: We haven't determined so far, but are assuming that is so. In the way aerosols are formed now your solution never changes its form. The oil is not evaporated; it is only broken up. There is one qualification. If you use Xylene in the formula, this evaporates and does not re-enter the particles.

DR. GLASGOW: Thank you, Mr. Latta.. You have brought out several very important points that merit special comment. (For resumption of Dr. Glosgow's comments, see continuation from manuscript submitted, beginning on page 27.)

In the afternoon session, Mr. Latta gave an extremely interesting and informative account of the fundamental studies of aerosol fogs and of particle size that are now being carried on at Beltsville; he did not leave a manuscript, and unfortunately, through a misunderstanding, a stenographic report of his talk was not made.

PRESIDENT RUTH: Dr. Glasgow has asked Dr. Collins to describe and demonstrate the technique employed by Dr. Collins and him to photograph and measure aerosol fog particles.

With a compound microscope and a Leica camera, Dr. Collins demonstrated the simple method of making simultaneously a photomicrograph of the aerosol fog droplets as collected on an oleophobic coated slide, together with the superposed image of a micrometer scale for their measurement.

The remarks accompanying the demonstration are printed below under the title *Technique Employed in the Study and Measurement of Aerosol Fog Droplets.* The general "set-up", and a few of the specimen photomicrographs which were shown as lantern slides, are reproduced.

TECHNIQUE EMPLOYED IN THE STUDY AND MEASUREMENT OF AEROSOL FOG DROPLETS

D. L. COLLINS
N. Y. State Science Service, Albany

For an accurate check on the performance of an aerosol fog generator with different formulas, and for a clear understanding of the possibilities and limitations of fogs composed of droplets of different average diameters, it was necessary to find some practical method not only of measuring but also of recording the droplet diameters.

For simplicity of manipulation, and for ease and speed with which permanent records may be made in the field during field experiments or actual control operations, the photographic method of studying particle size and other particle characteristics which was developed by the New York State Science Service has proven extremely useful.

Photomicrographs can be made literally as fast as the microscope can be focused and refocused on different areas of a slide. Thus a large series of permanent photographic records of droplet patterns, together with a superposed scale for the accurate measurement of the droplet diameters, may be made of significant, some-

times transitory, phases of a study, in a period of time otherwise much too brief for critical observation, counts or measurements.

Later, when there is time for careful and critical work, the measurements and special characteristics of individual particles may be noted. Determination of the number of droplets per unit area, and of the number and range of different sizes; distribution patterns; notes on the tendency of components to separate, evaporate, or crystallize, and other observations may be made. These observations may be made directly from the negatives, through a viewer; from projection images; or from photographic prints.

There is the added and significant advantage that records from a long series, from interrupted series, or from series made at widely separated intervals of time, may be compared one with another.

Comparisons of fogs or mists from different machines, from different adjustments of the same machine, or from different materials; comparisons of slides exposed at different levels, or at different distances or at different angles—all may be permanently recorded and brought together side by side for critical study at any later time, and may, perhaps, be studied eventually for details not thought of when the exposures were originally made.

The accompanying photomicrographs (Figs. 2 through 10) were chosen from among a large series to illustrate the facility with which some of the observations mentioned may be made, and the clarity with which details appear.

Because of the many questions asked regarding the methods used, the following brief general description of the materials and methods employed by us is given.

Materials and Equipment

CAMERA: A 35 mm. Leica or Argus; but any camera may be used.

MICROSCOPE: A compound microscope equipped with a complete Abbé substage condenser.

LENS COMBINATION: A 2/3 (16 mm.) objective (standard or microtessar) used with a 10-X ocular.

LIGHT SOURCE: A 100 watt type A Mazda lamp, in a goose-neck stand.

MIRROR: Concave.

MICROMETER SCALE: A standard ocular micrometer.

SLIDES: Standard 1 x 3 clear glass microscope slides covered with an oleophobic coating (fused zinc stearate).

ACCESSORY EQUIPMENT: A Leica or other standard copying stand, or a ringstand with ring or clamps for supporting the camera over the microscope.

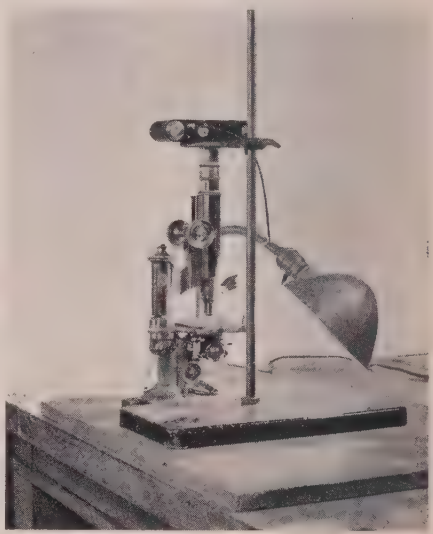


FIG. 1. Compound microscope and Leica 35-mm. camera, set up to take photomicrographs of fog droplets.

PROCEDURE: 1. PREPARATION AND EXPOSURE OF SLIDES. The slides were dusted with Merck Zinc Stearate toilet powder by means of a medium sized camel's hair brush. The brush was used also to rub off the excess powder, leaving the slide thinly coated with a white film of zinc stearate. The slide was then placed on a hot plate until the film of zinc stearate melted (fused). This film appeared to clear, but almost

immediately became slightly milky. Heating was then continued until the film again became clear. If the heating was stopped too soon, i.e., before the slide became perfectly clear again, very small, clear, semi-spherical particles remained and could be confused with the oil droplets subsequently deposited. Standard slide boxes containing slides treated in this way were prepared in advance and taken into the field when required. The exposures to the fog or mist were made by holding or placing the slides in the desired position, facing in the selected direction, either before, during or after the generation of the fog or mist, depending on the purpose in view.

Several oelophobic materials other than zinc stearate could be used, and are preferred by some investigators.

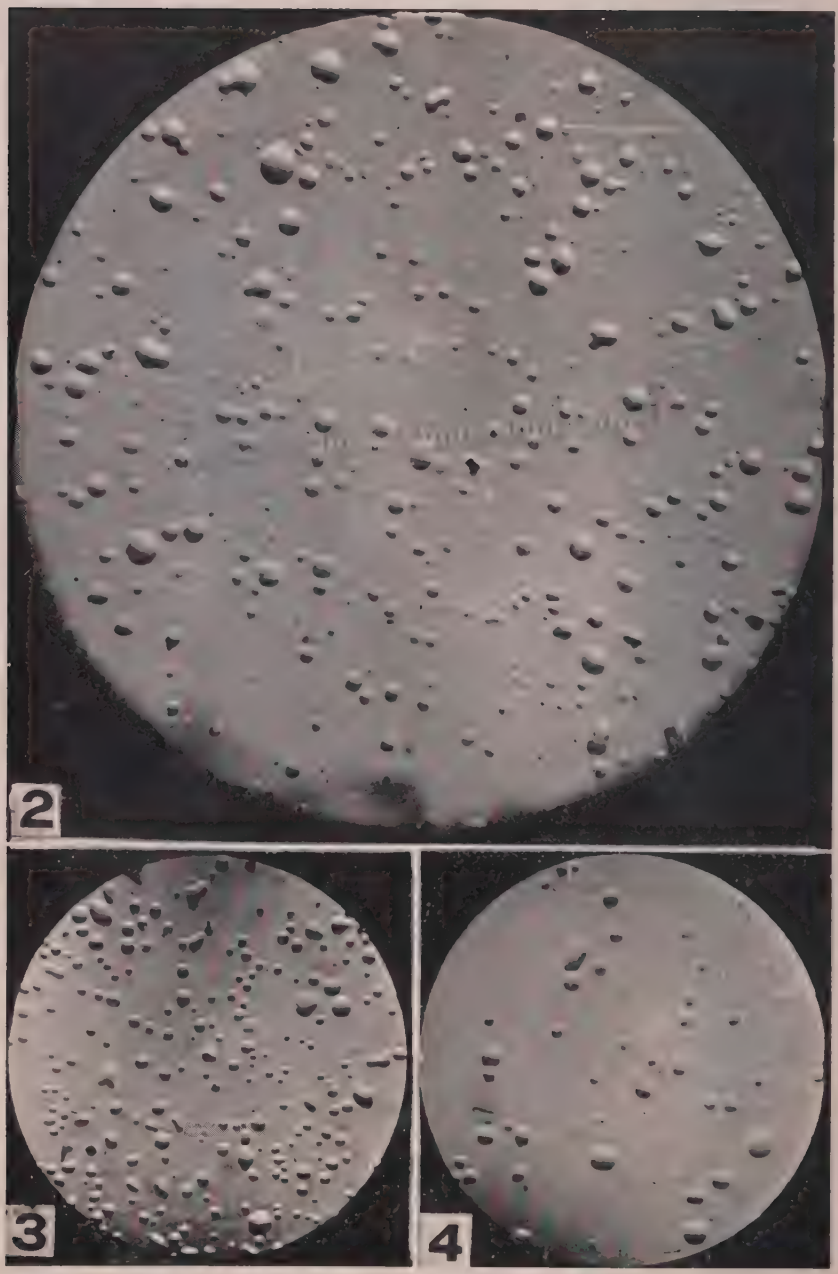
The slides may be placed back in the slots in the slide boxes as soon as they have been exposed, and stored until photographed. If the work is being done in the field, the microscope and camera may be quickly set up close to the scene of operation, wherever a table and a light source are available, and the photographs made "on the spot." With many solutions, such as some of the petroleum fractions used in our studies, the droplets remained unchanged for a considerable period and were photographed several hours to a day or more after exposure to the fog. With other materials, such as certain emulsions containing DDT in a volatile solvent, crystallization may occur very quickly. With others, evaporation is very rapid.

2. ADJUSTMENTS OF MICROSCOPE. The ocular micrometer was calibrated by means of a stage micrometer for the lens combination to be used. In the course of the work illustrated in the photographs three different ocular micrometers were used because of convenience at the time, each having been calibrated separately. Any other type that would photograph plainly in a similar manner could be employed. The position of the ocular diaphragm on which the micrometer was placed was adjusted to give the sharpest image under the lighting conditions used. In some of the work two ocular micrometers were used, one over the other, one with linear scale, and the other with a cross-line grating, facilitating counts and distribution studies as well as measurements (Fig. 10).

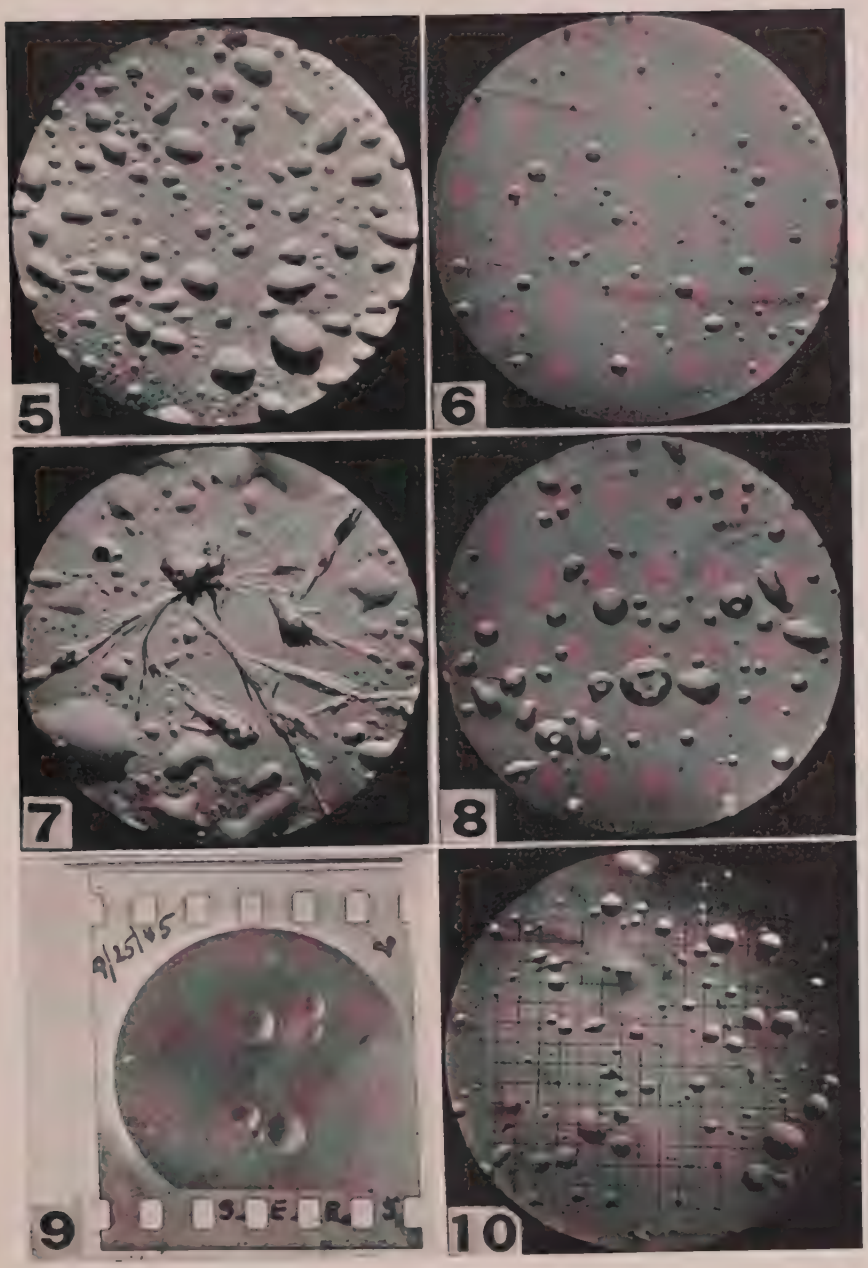
The coated slide bearing upon it the fog droplets was placed on the stage, and rapidly examined to locate typical fields for photographing. At this point the adjustment of the lighting is very important. In our work the rounded effect on the oil droplets was achieved by coordinating certain adjustments of various elements of the system. The light source was placed about 10 inches directly in front of the microscope at the level of the mirror, and the mirror was adjusted to a 45° angle. The substage condenser diaphragm was then centered and nearly closed, after which it was moved off-center to the "north east" about 1 mm. By varying these adjustments very slightly, that is, by opening or closing the diaphragm, or moving it more off-center or less off-center, or changing the angle of the mirror, or raising or lowering the condenser, or by a combination of these manipulations, the best "relief effect" which at the same time showed a contrast between the droplets and the background and allowed of sharp definition of the ocular micrometer scale, was achieved.

The appearance of the fog particles or droplets with these arrangements was much better than when a central dark field stop was used. A similar, although not superior, effect was obtained by the use of a Leitz Plankton condenser.

3. ADJUSTMENT OF THE CAMERA. The Leica copying stand was conveniently used to support the Leica camera above the microscope, and for the earlier work the ground glass focusing attachment was also used. With this, the camera may be slid out of position, at the same time bringing into the optical axis a ground glass screen at the same focal plane as the film in the camera. This device is unnecessary and cumber-



Figs. 2, 3 and 4. See text for explanation.



Figs. 5, 6, 7, 8, 9 and 10. See text for explanation.

some in rapid work, and for most of the photographs it was not used. In some (Fig. 1, for instance) a simple ringstand was used, with the ring used to suspend the camera so that its lens almost touched the ocular of the microscope. Essentially, it was only necessary to have the camera supported so that its lens was centered with the microscope ocular, and almost touched it. No light-lock or light-proof sleeve was necessary. As actually operated, the microscope was focused as described above, the camera was then placed over the ocular, with the lens diaphragm wide open and the lens focused at infinity, and the exposure made, using the cable release. The best light adjustment was usually found to be one that gave a good picture with a 2 sec. exposure with Ansco Isopan film (Weston Speed 32 with Tungsten lamp) or with Eastman Panatomic X. However, considerable latitude in exposure time from 1 to 5 seconds or even greater, with the same lighting, may be permitted, depending on the effect desired.

The above account is a description of the apparatus and procedure actually used in making the photomicrographs reproduced in figures 2 through 10. It is not implied that some other arrangement might not be just as suitable; for instance, the use of the Plankton condenser might be preferred by some, and other types of microscope lamp would undoubtedly be very useful. Also, other cameras would do just as well as the Leica and Argus. The details of our own work were given merely to show how simply and expeditiously these photographic records may be made by anyone with almost any camera and a microscope.

Examples and What They Show

Fig. 2. (Slide Y–1) A slide with good definition of both droplets and micrometer scale. The smallest division of the scale is equal to 10 microns. The droplet just to the left of the figure "5" thus has a flat diameter of about 40 microns. If the original unflattened spherical droplet is assumed to have half the diameter of a hemisphere of the same volume, then this would be a particle of 20 microns diameter. This assumption, of course, is not mathematically correct, and would be subject to a number of factors which, for present purposes need not be considered. All of the other particles can also be measured directly from the photographs. With appropriate calculations, the approximate volume of liquid in the field, or on the slide, could be determined, as well as the percentages of the total volume contained in droplets of any given size, and other data that might be desired for special purposes.

Figs. 3 and 4. (Slides X–1 and X–2) Two views of the same slide, Fig. 3 being a field near the edge of the slide and Fig. 4 a field near the center; slide was held vertically, so that fog impinged directly from the direction of the orifice. The "air cushion" effect in front of a flat surface, which causes a flow of air around it, allows fewer particles to reach the center, and especially, fewer small particles.

In the micrometer scale in Figures 3 and 4, and those that follow, each small division is equal to 8.5 microns.

Figs. 5 and 6. (Slides 5a and 5d) A comparison of slides exposed to the same fog for different lengths of time: Fig. 5, exposed for 22 hours in a room in which the fog was still present more than 20 hours after it was discharged; Fig. 6, exposed for 10 minutes in the same room at the beginning of the fogging. The fact that the smaller particles settled much more slowly is clearly evident. Coalescence of small drops to form large drops may also be noted on the slide exposed for the longer period.

Fig. 7. (Slide 3a) Slide showing crystallization of DDT from droplets collected from a DDT-oil emulsion fog.

Fig. 8. (Slide T) Slide showing separation of oil and water in the same droplets, obtained from a fog made by injecting oil and steam separately but simultaneously into the discharge orifice of the fog machine.

Fig. 9. Photograph to show appearance

of negatives as labeled and preserved for further reference. In most cases particle measurements may be made from the negatives, either directly or with a viewer, or by projection.

FIG. 10. (Slide 24–c–4) Shows appearance of field when two micrometers are superimposed in the eyepiece for measuring and counting.

RECAPITULATION AND CONCLUSIONS: From the figures quoted in Dr. Glasgow's paper it may be seen that in using the fog-producing mechanism efficiently for mosquito control, either against larvae or adults, attention must be paid to particle size. For "flash-kills" of adults, if the machine is delivering chiefly particles of the larger sizes, it may be wasting much of the material, since many of these particles are too large and heavy to carry far or hang long in the air.

On the other hand, for residual deposits, a shorter distance from the machine, the larger particles are desirable.

Comparisons and analyses made from these and similar photographs are assisting in perfecting the new machines for specific purposes and in adapting different chemical combinations for use in these machines, for more effective insect control.

NOTICE OF MEETING IN ILLINOIS

The following letter is self explanatory. Reserve these dates, and make your own plans accordingly.

February 26, 1947

"Mr. R. E. Dorer, Director,
U. S. Public Health Service,
Communicable Disease Center,
Essex Building, Bank and Plume Sts.,
Norfolk 10, Virginia.

Dear Mr. Dorer:

"At the last meeting of our board of trustees, Mr. Otto McFeely was appointed to make arrangements for travel, meals, halls, and entertainment. We shall have representatives from the six mosquito abatement districts in the state, the Chicago public health engineers, state engineers, and engineers from the two adjoining counties. We shall have a nice range of equipment to demonstrate; otherwise, the meeting is as you have listed it in your letter of February 3rd:

'May 8, 1947
Meet at office (Des Plaines Valley Mosquito Abatement District, 8130 Ogden Ave., Lyons, Ill.) at 9:00 A.M. Inspection, etc., until noon. Field inspection in afternoon. Meeting at night.

'May 9, 1947
Field inspection and any other points of interest. Adjournment at 5:00 P.M.'

"I have just checked the mosquito breeding record for the past three years and I find that we shall have plenty of larvae of the woodland group of mosquitoes and perhaps some adult mosquitoes which can be knocked down with a fog spray, so the above dates seem to coincide with our woodland breeding season.

"Please give me some idea of how many will attend so I can arrange for bus transportation.

Sincerely,
J. Lyell Clarke,
JLC:es Sanitary Engineer.

Had a chat with Dr. Hutson, Mich. State College, Lansing, several weeks ago.

The spraying of DDT at Mackinac Island was under his direction."

J.L.C.

NEWS AND NOTES

THE FLORIDA ANTI-MOSQUITO ASSOCIATION will hold its 1947 Annual Meeting in the Suwannee Hotel at St. Petersburg, Florida, April 27, 28, 29, and 30.

THE 34TH ANNUAL MEETING of the New Jersey Mosquito Extermination Association will be held at the Hotel Haddon Hall in Atlantic City, New Jersey, on April 2, 3, 4, 1947.

MR. HARRY STAGE, who is attending meetings of the Pan-American Conference on Malaria at Maracay, Venezuela, wrote on January 16: "This is a wonderfully perfect climate, every day, and every night like only the very nicest in Washington. Beautiful girls, handsome men, gorgeous flowers, and almost an orchid in every tree. After I leave here, I go to Surinam for three weeks more."

SUPERINTENDENTS OF THE CALIFORNIA MOSQUITO ABATEMENT DISTRICTS have been meeting at various places in the state for informal discussions of their problems. Representatives of the State Department of Public Health attend these meetings also. Recent meetings have been held at Fresno in July, Turlock in August, Marysville in September, Merced in November and Modesto in December. H. F. GRAY

THE YOLO-SACRAMENTO MOSQUITO ABATEMENT DISTRICT, recently organized, reports that considerable difficulties have occurred in starting their work. It was officially organized too late in 1946 to be able to obtain any funds from taxes for the 1946–1947 fiscal year, and it looks as if no work can be started until the spring of 1948 unless some financial aid is received from Yolo and Sacramento counties prior to that time. Considerable assistance was anticipated from State subvention funds, but such funds are not available unless local funds are available.

H. F. G.

THERE ARE 36 MOSQUITO ABATEMENT DISTRICTS IN CALIFORNIA as of December, 1946, with a number of others under consideration for organization. Some of the mosquito abatement district superintendents in California are suggesting that the California Mosquito Control Association employ a paid Executive Secretary and embark on a program of special services to the districts which can best be handled through a central coordinating office. The annual cost is estimated to be about $10,000, and it is proposed to raise the necessary funds by contributions from the districts of approximately one per cent of their annual budgets. H. F. G.

CLUFF HOPLA. (A letter from the Associate Editor.) "One of our newer members, now lives at 360 East, Eight South Street, Springville, Utah, with his wife and young son. I became acquainted with him during his duty at the Naval Medical School across the road (from the USPHS National Institute of Health, Bethesda, Maryland), when he used to visit our lab and discuss insects. The following information might be of interest for News and Notes. I quote from his letter that portion dealing with his activities.

" 'As you know, while overseas I was in charge of a Malaria-Control Unit in the southwest Pacific. On being released to inactive duty I resumed graduate studies at the Brigham Young University, Provo, Utah, and have plans of receiving my Master's Degree this June. For my thesis I am working on "The Mosquitoes of Utah County, Their Taxonomy, Biology and Distribution." Last summer I made a survey of the mosquito population for the county, with hopes of trying to get a control district set up. In that our work here is more or less of a pest condition than a medical one people are rather slow to accept something new of this nature. However, I still have hopes of getting one control district started here before the summer is over. I am teaching part time at the University which gives quite a heavy load.' "

H. L. T.

MOSQUITO CONTROL EXHIBIT AT NEW JERSEY STATE FAIR. Under the joint auspices of the New Jersey Mosquito Extermination Association, the New Jersey State Agricultural Experiment Station, and the various (N. J.) County Mosquito Extermination Commissions an educational exhibit relating to mosquitoes and their control was shown at the annual New Jersey State Fair, Trenton, N. J., during the period September 22 to 29, 1946.

Space was made available in the State Building, the arrangements being made by courtesy of Mr. R. W. Taylor, in charge of state exhibits.

The background of the exhibit was a series of photographs and charts, mounted on portable panels, originally exhibited at the 1946 Annual Meeting of the New Jersey Mosquito Extermination Association. Subject matter of the seven panels used was as follows:

1—Open salt marsh mosquito breeding conditions, and control.
2—Enclosed salt marsh mosquito control, dikes and tidegates.
3—Fresh water swamp and pool mosquito control.
4—Cooperation of various agencies.
5—Malaria in New Jersey.
6—Control of local mosquito breeding about homes.
7—Machinery in mosquito control.

Table exhibits included DDT, pyrethrum and fuel oil in the various forms as used for mosquito control, live and mounted mosquito larvae

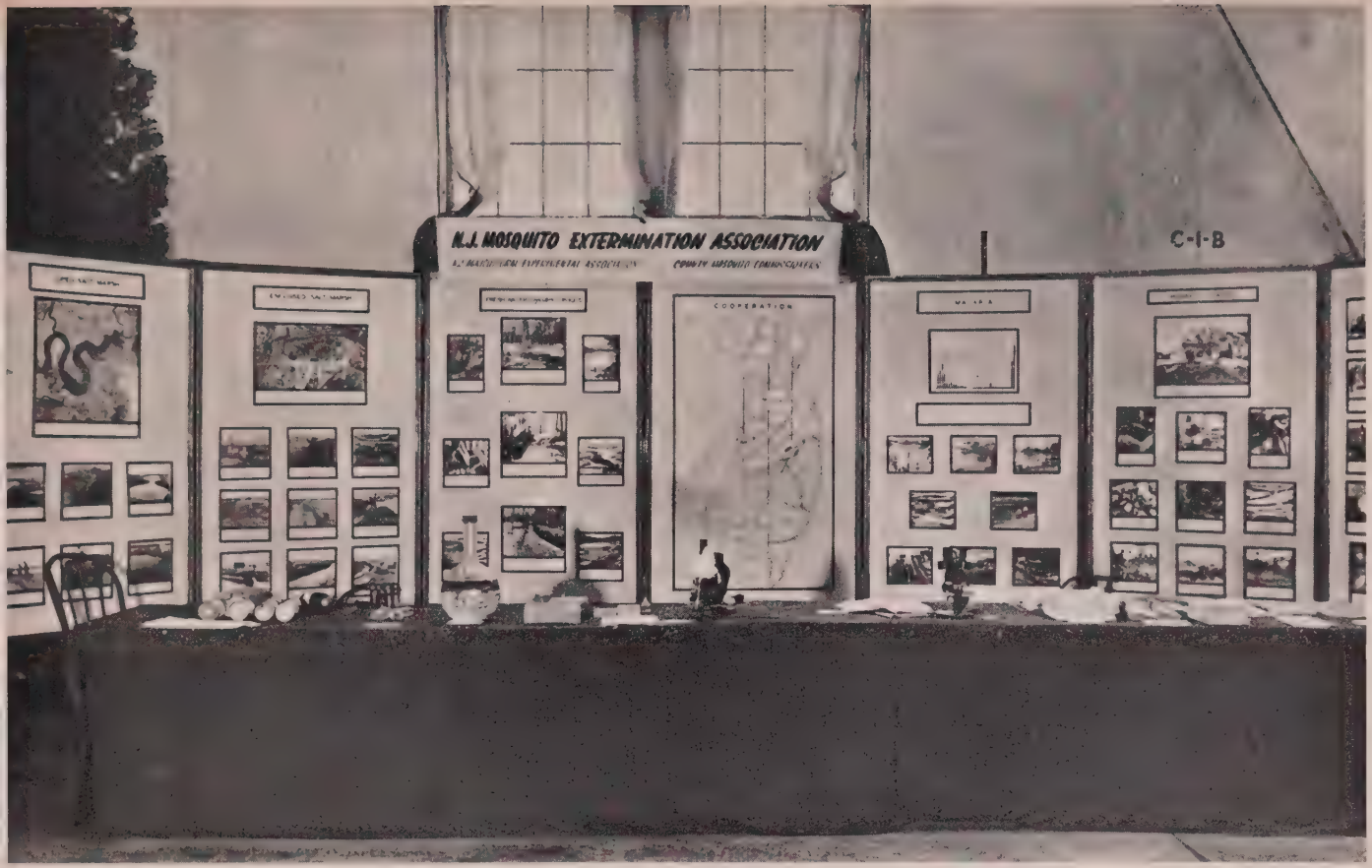


Exhibit shown at 1946 New Jersey State Fair, Trenton.

Photo courtesy of R. W. Taylor

and adults, and literature for distribution. Two microscopes were set up, one showing the differences in the appearance of various species of mosquitoes, and the other comparing normal and malaria infected blood cells. These microscope exhibits attracted a great deal of attention, and were used constantly.

Sample counts were made during the course of the exhibit, and it was determined that 20,000 people stopped at the booth to ask questions, examine the exhibit material, or pick up literature.

The various County Mosquito Extermination Commissions and the Department of Entomology of the New Jersey Agricultural Experiment Station furnished personnel to man the exhibit, on a rotating schedule with usually two or three persons serving together.

The exhibit was in charge of the following committee:

Dr. Alton B. Fell, Trenton, Chairman; Mr. Louis B. Pierce, Mr. Albert Lafferty, Trenton; Mr. Lester W. Smith, Metuchen, and the writer.

Previously much of the same material had been used at an exhibit shown before more than 1,000 members of the New Jersey Federation of Women's Clubs during their Annual Conference, held on May 14–17 at the Hotel New Yorker, New York City. The committee in charge at that time was Mr. Lester Smith, Metuchen; Mr. George Eager, Newark, and Mr. Marcus Donnelly, Jersey City.

THOMAS D. MULHERN, *Sec.*
New Jersey Mosquito Exterm. Assn.

THE EAST MIDDLESEX (MASSACHUSETTS) MOSQUITO CONTROL PROJECT was organized about the first of last year. It includes the towns of Arlington, Belmont, Lexington, and Watertown and the cities of Cambridge and Waltham—all located northwest of greater Boston. There is one Commissioner from each town or city who serves without pay and represents his town in the governing board. The Commission appoints a superintendent for the project.

Funds are received into the State Treasury from appropriations made each year from each town or city in the project. Bills and payrolls are paid out of the State Treasury according to our vouchers submitted through the State Reclamation Board. This State Reclamation Board has the authority to organize mosquito control as provided in Chapter 252 Section 1 to 14 inclusive of the General Laws, Tercentenary Edition.

Last season Mr. Richard Hinchy was appointed superintendent. This year I was appointed to that position immediately after leaving the Army.

The Project has operated on a seasonal basis, but in the future it is planned to operate through the winter on a restricted program. From eight to sixteen men have been employed during the active season. In addition there is a part time clerk and a part time inspector. Mosquito control work has been mainly improvement of drainage and oil spraying. Next season DDT formulations will be used more extensively in the temporary control program.

No power equipment is owned by the project. Practically all work being done with hand tools and sprayers. The budget is not large enough to take full advantage of mechanized equipment. However, two small trucks were purchased last March and we expect to purchase a "Jeep" next March and equip it for catch-basin and field spraying, or fogging, with apparatus designed to get the best results out of DDT formulations. Any practical suggestions in this line will be most appreciated.

We have been rather cautious in our relations with DDT thus far. We did not have enough information to make it advisable to adopt that material in place of oil and our equipment was not designed for the light applications adaptable to DDT. Next year we will probably use wettable DDT in our power sprayer and use the emulsion in our 3 gallon compressed air sprayers after fitting them with fine nozzles. This ought to carry us along until various other machines now on the market have passed out of the experimental stages.

Very truly yours,
ROBERT L. ARMSTRONG
Superintendent

STATE MOSQUITO CONTROL GROUP IS FOURTH IN U. S. Perry W. Ruth, Officer of City Commission, Named President. The Virginia Mosquito Control Association has been formed here, the fourth such organization in the United States, and Perry W. Ruth, secretary and technical advisor for the newly created Norfolk City Mosquito Commission and former president of the American Mosquito Control Association, unanimously was elected its first president.

This was announced yesterday by R. E. Dorer, director of mosquito control for the Virginia State Department of Public Health, in whose office in the Essex Building the organization meeting was held Friday.

Ruth for about 13 years was superintendent of the city mosquito control bureau, until he was retired at the end of last year. However, Dr. John M. Huff, director of the City Department of Public Health, persuaded the City Council to change the mosquito control organization so Norfolk would be a separate district with a commission empowered to employ Ruth as administrative officer. As a consequence, the commission is allotted $5,000 a year from the State for mosquito control, which was not available until the district was created. Dr. Huff, Director of Public Works, Henry H. George, 3d, and Dorer are members of the local commission. Dorer is chairman, and also is a member and chairman of all similar commissions in Virginia.

Other officers of the new association were announced as follows:

Stuart Gibson, Elizabeth City county deputy clerk and member of that county's mosquito commission, first vice president; Peyton May, member of the Virginia Beach-Princess Anne County commission, second vice president; J. C. Morris, Warwick County manager, third vice president; R. E. Dorer, director of mosquito control for the Virginia State Department of Public Health, secretary and treasurer. Dorer acted as temporary chairman of the organization meeting.

Dorer said the association is open to membership for anyone interested in mosquitoes and mosquito control work, and that its function will be "to promote more effective mosquito control in Virginia, to maintain public interest so far as possible wherever mosquitoes are being controlled, to keep up with the latest methods of control, to keep the public and officials informed on work being done, and to unite and coordinate all common interests and efforts in the fight against mosquitoes."

Only three other States have such associations—Florida, New Jersey and California.

The organization meeting also elected the following directors:

Dr. L. J. Roper, Virginia State health commissioner; Dr. John M. Huff, Norfolk city health director; Dr. L. H. Denny, Portsmouth city health officer; Sol Ellenson, Newport News director of public works; Henry H. George, 3d, Norfolk director of public works; John Taylor, chairman, Norfolk County board of supervisors; Paul Rogers, Northampton County engineer; Jonathan Gibson, member Warwick County Mosquito Control Commission; George W. Price, assistant director of Norfolk Redevelopment and Housing Authority; V. D. McManus, member Williamsburg city council; Mrs. Joseph C. Nelson, president, Federation of Garden Clubs of Norfolk and Vicinity; Mrs. James S. Barron, London Bridge; Maj. Richard Messer, director of sanitary engineering for Virginia State Health Department; Norfolk Director of Public Welfare H. G. Parker; Dr. Lee Todd, Newport News city health officer; the Rev. G. T. Forrester, member of the Virginia Beach-Princess Anne County Mosquito Commission; Clifford Mitchell, sanitary engineer for the Richmond Health Department; W. S. Harney, manager Norfolk Association of Commerce, the medical officer for the Fifth Naval District and the chief surgeon for the U. S. Army in this area, regardless of the men in these positions at any time, and C. Edward Temple, Hopewell city manager. —From *Norfolk Virginian-Pilot,* Sunday, January 26, 1947, Norfolk, Virginia.

NEW FIRM TO BUILD TODD INSECTICIDAL FOG MACHINE ABROAD. Todd Shipyards Corporation has joined with the British manufacturing firm of R. A. Lister, Ltd., of Dursley, England, to form a new company, Lister-Todd, Ltd., of London, for the manufacture and sale throughout the British Empire, and in Europe and Asia, of the Todd Insecticidal Fog Applicator.

A RESUME OF THE PROCEEDINGS AND PAPERS OF THE 15TH ANNUAL CONFERENCE OF THE CALIFORNIA MOSQUITO CONTROL ASSOCIATION. The 15th Annual Conference of the California Mosquito Control Association held December 13th and 14th, shared the year 1946 with the 14th Annual Conference which was held February 25th and 26th. The holding of the 15th Conference in 1946 was due to 1947 being a legislative year (the State Legislature meets on a bi-annual basis) and certain vital mosquito control legislation had to be submitted in order that it could be approved by the Association before the beginning of the legislative session. Actually, the war years caused cancellation of the conferences in 1942 and 1943, so the holding of the two conferences in one year brings us within a year of making the numbers of the conferences coincide with the years of such meetings of California mosquito control workers.

In addition to the standbys from the far western states, we are pleased to mention that others in attendance ranged from Washington, D. C., Georgia, Alaska, Hawaii, the Canal Zone, and Argentina. The attendance register bore a total of 125 signatures.

In general the program was divided into the following parts: introductory addresses; Association business; State and Federal mosquito control and related activities; current mosquito control and related literature; recent developments in the studies of the arthropod-borne virus encephalitides; new mosquito control techniques; the use of DDT and its trends; the State subvention program and studies; the place of mosquito control in regard to over-all water use; mosquito control legislation; and, reports of district activities.

The feature address of the dinner meeting was given by Harold F. Gray, who related his recent experiences in the control of mosquito-borne disease in Japan. Dr. L. W. Hackett, who happened to be vacationing in the Bay Region at the time of the Conference, took time off from his vacation to attend and also presented an interesting talk on his activities in Argentina. Dr. Justin M. Andrews outlined the structure and scope of the activities of the newly-created U.S.P.H.S. Communicable Disease Center, which supplied us all with a better appreciation of the broad arthropod-borne disease studies of the Service. H. H. Stage outlined for the audience the place and function of the American Mosquito Control Association in respect to our Association. Bureau associates of his who were also present were: A. R. Roth, A. W. Lindquist, C. M. Gjullin, and C. S. Wilson. Mr. Gjullin presented a paper on DDT prehatching treatment of *Aedes* eggs. Dr. Robert L. Metcalf, University of California, related his experiences while employed by the Tennessee

Valley Authority with the use of airplane thermal aerosol in the control of anopheline mosquitoes. Dr. Wilton L. Halverson, State Director of Public Health, indicated the interest of the State Health Department in local California mosquito control practice. Dr. W. McDowell Hammon, and Dr. Wm. C. Reeves of the G. W. Hooper Foundation enlightened the group concerning the encephalitides by touching upon their 1946 studies in California. Dr. L. M. Breslow, California State Health Department, related his epidemiological observations of encephalitis in California during 1946. Dr. James R. Douglas, University of California, supplied many helpful facts on controversial issues to clarify the place of DDT as its use relates to animals and humans. As a result of the discussion that followed this paper, the following resolution was adopted by the Association:

> WHEREAS, the experience of various mosquito control districts in California during the past two years has shown that in dichloro-diphenyl-trichloroethane (DDT) we possess a material which is extremely useful and valuable as a mosquito larvicide and adulticide, with concurrent value in the control of flies, fleas and other hominoxious arthropods, now, therefore, be it
>
> RESOLVED, that we strongly recommend the use of DDT by all mosquito abatement districts and health departments in appropriate situations; that we find that this material enables us to combat these insects with greater certainty and effectiveness than heretofore; that we are confident that its use will result in economies in operation; and that we find that when properly used by trained and experienced persons the material is harmless to man and domestic animals, to crops and to wildlife.

Professor W. B. Herms, Emeritus, supplied the group with notes and references to mosquito control happenings of significance elsewhere in the United States and throughout the world. Frank M. Stead, Chief of the State Division of Environmental Sanitation, delivered a very stimulating address concerning the interrelation of mosquito breeding to the over-all use of the State's water supply viewed in terms of water as a natural resource. A. H. Dahl, Chief of the State Mosquito Control Section, reviewed the internal relations between the State and the various districts in regard to the subvention program. A number of interesting papers were presented by district superintendents who had performed specialized control measures in their respective districts. Two of the legislative matters which were approved by the Association for submission to the State Legislature concerned provision for new districts to finance operations upon forming through borrowed monies for the period of a fiscal year immediately previous to that which will net them revenue from taxation, and changing the means for contiguous mosquito abatement districts consolidating by abandoning the need of a special election in favor of a joint resolution of consolidation by respective boards of trustees. Several other amendments pertaining to internal matters were also approved.

Generally, the meeting proved to be very successful with the only common criticism being that insufficient time was allowed to cover all the subject matter.

An Executive Committee was named to act as a medium for screening Association business and planning. The Committee is composed of the officers of the organization, the out-going President, a member of a Board of Trustees, a representative of the State Department of Public Health, and a superintendent at large from the various mosquito abatement districts.

The officers and Executive Committee for the calendar year 1947 are:

President: Arthur F. Geib, Manager, Dr. Morris Mosquito Abatement District, Bakersfield, California.

Vice-President: Theodore G. Raley, Superintendent, Consolidated Mosquito Abatement District, Selma, California.

Secretary-Treasurer: Richard F. Peters, Mosquito Control Specialist, State Health Department, Berkeley, California.

Executive Committee: Arve H. Dahl, Chief, Mosquito Control Section, State Health Department, Berkeley, California; Harold F. Gray, Engineer, Alameda County Mosquito Abatement District, Oakland, California; William B. Herms, Trustee, Alameda County Mosquito Abatement District, Oakland, California; E. Chester Robinson, Superintendent, Eastside Mosquito Abatement District, Modesto, California.

The Proceedings and Papers of the 15th Annual Conference are expected to be published about March 1, 1947.

EDITORIAL SECTION

A PERMANENT FUND FOR THE AMERICAN MOSQUITO CONTROL ASSOCIATION

Many well established national and international scientific and professional associations have found it expedient to establish and maintain what is termed a "permanent fund." Typically, the capital amount of such a permanent fund is invested in securities that are legal investment media for savings banks, and the fund is managed by a committe of members experienced in business affairs. Usually, the capital of such a permanent fund may be drawn upon only in extreme emergency, and only when authorized by vote at an annual meeting of the Association; usually, by constitutional provision, any surplus of income over operating expenses at the end of each year is added to the permanent fund; usually, the annual income from the permanent fund is earmarked for special research, or for other special objectives of the Association, but may, if needed, and only on vote of the Executive Committee, be used to meet any deficit in operating expenses. If not so used, such annual income from the permanent fund will automatically revert to, and become a part of the permanent fund itself.

The American Mosquito Control Association is a young organization, and hitherto has chosen to "plow back" all of its current income into the publication of Mosquito News, and into the promotion of activities calculated to make the Association more valuable to its members.

Recently it was decided that the Association has become strong enough to justify starting a permanent fund. The first step was to appoint the Committee on Permanent Fund, announced in the September, 1946, number of Mosquito News as follows:

Committee on Permanent Fund

Mr. Frank K. Steinrock, Engineer, Chairman, Vice President, Todd Shipyards Combustion Equipment Division, 601 West 26th St., New York City

Mr. H. W. Van Hovenberg, Sanitary Engineer, St. Louis Southwestern Railway Co., Box 288, Mt. Pleasant, Texas

Mr. Stanley W. Carpenter, Entomologist, National Biscuit Co., 448 West 14th St., New York City

The President, and the Secretary-Treasurer of the Association are ex-officio members of this Committee.

This Committee on Permanent Fund will explore the general field of its objectives, and will make recommendations to the Committee on Constitution concerning appropriate changes in the Constitution and By-Laws which might best facilitate its work.

Possible income producing activities of the Association are under consideration. Suggestions toward this end will be welcome.

REVIEWS AND ABSTRACTS

LOS ANOFELINOS DE LA ISLA DE GRAN CANARIA. By J. M. Romeo Viamonte, 1946. Rev. de Sanid. e Hig. Pub. [Madrid] 20(5):449–455. (Abstract of author's summary.)

During a brief stay in the Gran Canaria [one of the Canary Islands] the author collected 96 adults of *Myzomyia hispaniola* and 23 of *M. sergenti.* Characteristics differentiating the two species are given. Although both are considered malaria carriers of little significance on the island, the author saw endemic malaria of some importance due to these species. The habits and life cycle of the two appear similar since larvae and adults of both are found in the same situations.—HELEN SOLLERS, U. S. Bureau of Entomology and Plant Quarantine. Translated by Clark Collins, Columbia University.

NOTA PREVIA SOBRE UN NUEVO MÉTODO DE LUCHA ANTILAVARIA CON EL HEXACLORURO DE BENCENO (666). By Alvaro Lozano Morales. 1946. Rev. de Sanid. e Hig. Pub. [Madrid] 20(5):456–459.

In the laboratory, benzene hexachloride was found to be toxic to larvae of *Culex pipiens, C. hortensis, Theobaldia annulata, T. longeareolata, T. fumipennis, Aedes rusticus, Anopheles maculipennis atroparvus,* and *A. claviger.* Benzene hexachloride dust, although lethal to both *Culex* and *Anopheles,* killed the latter more quickly. However, an emulsion containing 10 per cent 666 was equally effective against both.

The author feels that the two genera apparently ingest microscopic particles of this insecticide. The optimum dose per cubic meter of water was found to be 10 cc. of the emulsion for anophelines and 15 cc. for culicines. In the laboratory larvae died within a few hours, usually within one hour.

Even though the emulsion had been mixed for more than 15 days, it still retained its power to kill larvae in experimental jars. In the field, immediate effect of this emulsion was noted on the larvae, particularly those of *Culex* and *Theobaldia* of which even the pupae were killed.

In the near future, the author proposes to give more complete details concerning these experiments.—HELEN SOLLERS, U. S. Bureau of Entomology and Plant Quarantine.

INSECT MICROBIOLOGY. By E. A. Steinhaus. Comstock Publishing Co., Inc. 763 + x pp. 1946. This unique book, though its implications are wide, is of interest to all workers in the field of insect biology and control. It is an extensive account of the microbes associated with insects and acari (ticks and mites) with special reference to the biologic relationships involved. The author points out that while it is not a book on insect pathology or on medical entomology, an attempt has been made to include biologic relationships existing between pathogenic agents and their arthropod hosts and vectors as well as all those between non-pathogenic agents and insects, ticks, and mites in general.

There are 13 chapters, each dealing separately with the following subjects, extracellular bacteria and insects, specific bacteria associated with insects, intracellular bacteriumlike and rickettsialike symbiotes, rickettsiae, yeasts and insects, viruses and insects, fungi and insects, spirochetes associated with insects and ticks, protozoa and insects, protozoa and termites, immunity in insects, methods and procedures. There are 88 pages of references and an author index comprising 12 pages. The subject index deserves high praise; it consists of over 57 pages. There are nearly 270 separate references to mosquitoes in the index, e.g., *Culex tarsalis* Coq., associated with bacterium, *Pasteurella tularensis,* p. 166 and p. 168; associated with viruses, encephalitis p. 438, St. Louis encephalitis p. 438 and p. 439, western equine encephalitis p. 438 and p. 439.

Dr. Steinhaus, the author, is widely known for his excellent contributions in the field of biologic relationships existing between agents pathogenic for man, animals, and plants, as well as those between non-pathogenic microbes and their hosts. The author is to be highly commended for bringing together in systematic form this mass of hitherto practically unavailable information. Dr. Steinhaus was formerly a member of the United States Public Health Service, and is now a member of the Department of Agriculture, University of California, Division of Biological Control, Berkeley, California.—W. B. HERMS.

THE INSECTICIDE SITUATION. By F. C. Bishopp. J. Ec. Ent. 39(4):449–459, 28 refs. 1946. Due to conditions brought about by the war, it became impossible to obtain adequate supplies of copper, pyrethrum, and rotenone for the manufacture of essential insecticides. This resulted in strict allocations of these materials to meet the more pressing needs, and intensive research to find new insecticides. In this article the author directs attention to the unprecedented pace with which research in the insecticide field is pressing forward and briefly reviews the following: seed treatments, fumigants, insecticidal materials of plant origin, and synthetic organic compounds. Several insecticides, including *sabadilla, Ryania, hydroxypentamethylflavan, benzene hexachloride, DDT, TDE, methoxy analog of DDT, bromine and fluorine analogs of DDT, benzyl benzoate, sulfones,* and *synergists* are discussed in some detail.

The effects of benzene hexachloride (1, 2, 3, 4, 5, 6-hexachlorocyclohexane) upon different insects as reported by various research workers is reviewed. Attention is directed to the need of

much chemical, biological, and toxicological work on this promising insecticide before its potentialities and limitations can be fully known. As one would expect, DDT still holds the spotlight in the insecticide field. Due to its general availability, the public has had the opportunity to evaluate DDT. In spite of all the research conducted with DDT and its acclaim by the public there are still many things to be learned, particularly the many possible secondary effects of DDT applications.

It is assumed that because of the interest resulting from publicity given insect control during the war and the increased problems resulting from the war, the use of insecticides in the United States and other parts of the world will be greatly increased. The United States is expected to take a leading part in the production of insecticides for other countries. The development of DDT put new life and hope into our endeavor to find potent insect killers among chemical groups previously thought to hold little promise as insecticides. Many other new insecticide developments may be expected within the next few years. The author stresses the fact that synthetic organic insecticides are more or less specific and one must not expect any one of them to be a panacea. Thus the search for other insecticides to close the gaps in insect control must continue.—S. J. Carpenter, National Biscuit Company, New York, N. Y.

War Losses Among Insect Collections and Entomologists in Japan. By C. L. Remington. Ann. Ent. Soc. Am. 39(3):448–450. 1946. The author has assembled information on the extent of destruction to insect collections, particularly to types, and to casualties among entomologists in Japan. Most of the insect collections with their numerous types were undamaged. However, there were two exceptions both in Tokyo. The extensive slide collections of parasitic mites and mosquito pupae prepared by Y. Asanuma at the Research Institute of Natural Resources were completely destroyed by incendiaries. Few types, if any, were lost, because Asanuma's studies were in manuscript form; and the destruction of this manuscript before publication precluded the designation of any of the lost collection as types. The other loss due to incendiary raids on Tokyo was the collection of the Tokyo College of Agriculture, which contained the large number of aquatic Coleoptera assembled by Dr. K. Lamiya. Types of aquatic Coleoptera and some Staphylinidae were destroyed with this collection. There were no casualties from the bombing among entomologists in the home islands of Japan according to the information obtained by the author. The greatest loss to entomology from the raids was the literature. The stocks of numerous booksellers and publishers of Tokyo and the smaller cities were burned out completely.—Louise Goode, Natl. Inst. Health, Bethesda, Md.

War Losses Among Insect Collections and Entomologists in Japan. (Pérdidas de colecciones de insectos y entre los entomólogos en el Japón debidas a la guerra.) Por C. L. Remington. Ann. Ent. Soc. Am. 39(3):448–450. 1946.

El autor ha reunido datos sobre el monto de la destrucción de colecciones de insectos, especialmente de tipos, y acerca de las fatalidades que hubiera entre los entomólogos en el Japón. La mayor parte de las colecciones con sus numerosos tipos no sufrieron daño alguno. Hubo, sin embargo, dos excepciones en Tokio. Las extensas colecciones de láminas de ácaros parasíticos y ninfas de mosquitos preparadas por Y. Asanuma en el Instituto de Investigaciones de Recursos Naturales, fueron destruidas completamente por bombas incendiarias. A lo sumo, pocos tipos se perdieron, porque los estudios de Asanuma estaban todavía en forma manuscrita y la destrucción del manuscrito antes de que fuera publicado impidió que ejemplar alguno de la colección perdida fuese designado como tipo. La otra pérdida que se debió a los ataques contra Tokio con bombas incendiarias fué la colección de la Facultad de Agricultura de Tokio, la cual contenía el gran número de Coleóptera acuáticas reunido por el Dr. K. Lamiya. Algunos tipos de Coleóptera acuáticas, así como algunas Staphylinidae, fueron destruidos junto con esta colección. No hubo fatalidades entre los entomólogos en las islas principales del Japón a causa de los bombardeos, según los informes recibidos por el autor. La pérdida más grave sufrida por la entomología debida a los ataques fué la de la literatura. Las existencias de muchas librerías y casas editoriales de Tokio y de las ciudades de menor importancia fueron consumidas completamente por los incendios.—Translation of review by Louise Goode.

Aedes Atropalpus (Coq.) a New Mosquito Vector of *Plasmodium gallinaceum* Brumpt. By H. L. Trembley. J. Parasit. 32(5): 499–501. 1946. The author describes the infection of *Aëdes atropalpus* with *Plasmodium gallinaceum*, compares the incidence and intensity of the infection in this species with those observed in *A. aegypti*, and records the transmission of the infection by *A. atropalpus* to the domestic fowl. In preliminary tests, 53 *A. atropalpus* were examined from 12 different lots, and 45 infected mosquitoes were found. Five tests were carried out to compare the incidence of infection, and 4 to compare the intensity of infection in the 2 species of mosquitoes. In each test, 100 *A. aegypti* were exposed to an infected chick, after which the engorged females were removed by means of a suction tube. The *A. atropalpus* were then applied singly to the same infected chick.

For comparison of incidence, the midguts, salivary glands, or both, were examined; and the *A. atropalpus* showed 78 positive out of a total of 87 mosquitoes (89.65 per cent); the

A. aegypti showed 56 positive mosquitoes out of 87, or only 64.35 per cent. For intensity studies, the midguts of 37 mosquitoes of each species were examined prior to the rupture of the oöcysts. The range in the number of oöcysts in *A. atropalpus* was from 0 to 479, with a mean of 111.94. In the *A. aegypti,* the range in the oöcyst counts was from 0 to 131, with a mean of 9.75.

P. gallinaceum was transmitted by *A. atropalpus* through 3 successive generations of chicks. The course of infection followed essentially the same pattern as that when the malaria was transmitted by *A. aegypti.*—LOUISE GOODE, National Inst. Health, Bethesda, Md.

AEDES ATROPALPUS (COQ.) A NEW MOSQUITO VECTOR OF *Plasmodium gallinaceum* BRUMPT. (*Aëdes atropalpus* (Coq.) Un Nuevo Mosquito Vector del *Plasmodium gallinaceum* Brumpt.) Por H. L. Trembley. J. Parasit. 32(5):499–501. 1946. El autor describe la infección del *Aëdes atropalpus* por el *Plasmodium gallinaceum,* confronta la incidencia y la intensidad de la infección en esta especie con las observadas en el *A. aegypti,* y deja constancia de la transmisión de la infección por el *A. atropalpus* a la ave doméstica. En pruebas preliminares, 53 *A. atropalpus* tomados de 12 grupos distintos fueron examinados, y fueron hallados 45 mosquitos infectados. Se llevaron a cabo cinco pruebas para comprobar la incidencia de infección y cuatro para averiguar la intensidad de infección en las dos especies de mosquitos. En cada prueba, 100 *A. aegypti* fueron expuestos a un polluelo infectado, retirándose después las hembras engulli-das por medio de un tubo de succión. En seguida los *A. atropalpus* fueron aplicados uno por uno al mismo polluelo infectado.

Con el fin de hacer una comparación de la incidencia, los intestinos medios, las glándulas salivares, o ambos, fueron examinados. El *A. altropalpus* dió 78 positivos de un total de 87 mosquitos (89,65 por ciento); el *A. aegypti* dió 56 mosquitos positivos en 87, o sea, solamente 64,35 por ciento. Para los estudios sobre la intensidad, se examinaron los intestinos medios de 37 mosquitos de cada especie antes de la ruptura de las cápsulas larvarias. El número de cápsulas larvarias en los *A. atropalpus* fluctuó entre 0 y 479, con un promedio de 111,94. En las *A. aegypti,* la fluctuación en la cuenta de cápsulas larvarias fué entre 0 y 131, con un promedio de 9,75.

P. gallinaceum fué transmitido por los *A. atropalpus* a través de tres generaciones sucesivas de polluelos. El curso seguido por la infección fué más o menos el mismo que el seguido cuando el paludismo se transmitia por *A. aegypti.*—Translation of review by Louise Goode.

CONTRIBUCIÓN AL ESTUDIO DE LA BIOLOGÍA DEL "*A. maculipennis* VAR. *atroparvus*" EN FUNCIÓN DEL AMBIENTE. DENSIDAD Y CICLO ANUAL. (Contribution to the Study of the Biology of *A. Maculipennis* var. *Atroparvus* in Relation to Environment. Density and Annual Cycle.) By Alvaro Lozano Morales. Rev. Sanid. e Hig. Publ. 20(3):239–250. 1946. Madrid, Spain. An interesting study of the influence of certain environmental factors on the annual cyclic change in density of *A. maculipennis* var. *atroparvus.* The author stresses the importance of determining anopheline density in anti-malarial work and in so doing justifies a study of factors influencing density. The observations were made in an insectary which is described in detail and in which meteorological data were carefully recorded. In addition, weekly systematic collections were made in a typical native shelter to obtain comparative data from the natural environment.

The data obtained are presented under the headings: Material and method; number of generations; variations in sex; and seasonal variation of anopheline density, and are accompanied by 2 diagrams, 2 charts, and a table. According to the author's interpretation of the data, 7 generations were produced in the insectary and 9 in the field. The variation in numbers between the sexes, consisting in a greater number of females than males, is accounted for by the shorter life span of the male. The cyclic seasonal variation in density consists of lows in March–April and July–August–September, with highs in May–June–July and October–November. Reproductive activity is not interrupted at any time but cyclic density of *atroparvus* during the period of malaria is the result of: (1) maximum density, conditioned by temperature, humidity, and rains; (2) mortality, influenced primarily by temperature: and (3) median density, by humidity. The article is an excellent presentation of specific data, with a careful and modest summary by the author.—DON M. REES, University of Utah, Salt Lake City, Utah.

CONTRIBUCIÓN AL ESTUDIO DE LA BIOLOGÍA DEL "*A. maculipennis* VAR. *atroparvus*" EN FUNCIÓN DEL AMBIENTE. DENSIDAD Y CICLO ANUAL. Por el Doctor Alvaro Lozano Morales, Director del Instituto Antipalúdico de Navalmoral de la Mata. 20(3) Marzo de 1946, 239–250, Rev. Sanid. e Hig. Públ. Madrid, España.

Un estudio muy interesante de la influencia de ciertos factores en el ambiente sobre los cambios en la densidad del *A. maculipennis* var. *atroparvus* durante el ciclo anual. El autor subraya la importancia de la determinación de la densidad anofelina en el trabajo antipalúdico y, al hacerlo, justifica el estudio de factores que ejercen una influencia sobre esta densidad.

Las observaciones fueron hechas en un insectario del cual se hace una descripción detallada y en el cual se llevó un registro exacto de los datos meteorológicos. Además, se hicieron capturas sistemáticas semanalmente en un abrigo indígena típico para obtener datos comparativos de un ambiente natural.

Se presentan los datos obtenidos bajo los siguientes rubros: Material y método; número

de generaciones; variaciones en el sexo; y variación estacional de la densidad anofelina, y se acompañan 2 diagramas, 2 gráficos y 1 cuadro. Según la interpretación de los datos hecha por el autor, se produjeron 7 generaciones en el insectario y en 9 en el campo. La variación de números entre los sexos, que consiste de mayor número de hembras que de machos, se atribuye al período vitalicio más corto del macho. La variación de densidad debida al ciclo estacional, consiste de bajas en marzo–abril y julio–agosto–septiembre; con elevaciones en mayo–junio–julio y octubre–noviembre. La actividad reproductiva no se interrumpe en ninguna época, pero la densidad cíclica del *atroparvus* durante el período infectivo del paludismo se debe a: (1) densidad máxima a consecuencias de la temperatura, la humedad y las lluvias; (2) mortalidad, ejerciendo la influencia primordial la temperatura; y (3) la densidad media, en función de la humedad. El artículo es una presentación excelente de datos específicos con un resumen concienzudo y modesto por el autor.—DON M. REES.

LE FROID ET LES FACTEURS D'ÉCLOSION DE L'OEUF CHEZ L'*Aëdes geniculatus* OLIV. (Cold and Factors in Hatching the Egg of *Aëdes geniculatus* Oliv.) By E. Roubaud and J. Colas-Belcour. Bul. Soc. Path. exot. 38:111–118. March–April 1945. The authors have conducted experiments to determine the factors responsible for the hatching of the eggs of *Aëdes geniculatus* Oliv.

I. Stimuli applied several weeks after oviposition: The tests indicated that during the first 3 months following oviposition the eggs failed to react to the various stimuli to hatching, i.e., alternate drying and flooding, mechanical agitation, temperature changes, and the use of mud from the natural resting places to contaminate the water. It was only after 3½ months that hatching occurred in 1 lot of eggs maintained in a moist environment followed by flooding.

II. Stimuli applied to the eggs after a latent period of 8 to 13 months: The hatching response to the stimuli mentioned above was much greater in the older eggs. The authors indicate that this marked aptitude for hatching is present only in eggs that have been retained under favorable moisture and temperature conditions. Despite the lack of prolonged lower temperatures encountered in natural hibernation, it was thought that a slightly elevated temperature played a role in their reactivation.

III. Influence of low temperature: In these tests it is shown that the eggs hatch much better in response to different stimuli after undergoing several months of low temperatures. The authors conclude that the various hatching stimuli are of little value prior to a dry latency of several months. If a portion of the time is passed at a low temperature (0°–12° C.) reaction to hatching stimuli is increased.—DONALD MACCREARY, Del. Agri. Expt. Sta., Newark, Del.

LE FROID ET LES FACTEURS D'ÉCLOSION DE L'OEUF CHEZ L'*Aëdes geniculatus* OLIV. (El Frió y los Factores en la Incubación de los Huevos del *Aëdes geniculatus* Oliv.) Por E. Roubaud y J. Colas-Belcour, Bul. Soc. Path. Exot. 38:111–118. Marzo–abril 1945.

Los autores han llevado a cabo experimentos para determinar los factores que influyen mucho en la incubación de los huevos del *Aëdes geniculatus* Oliv.

I. Los estímulos aplicados algunas semanas después de la oviposición: Las pruebas indicaron que durante los tres primeros meses siguientes a la oviposición, los huevos no manifestaron reacción alguna a los varios estímulos a la incubación, es decir, la alternación de secamiento e inundación, la agitación mecánica, los cambios de temperatura y el empleo de fango, tomado de los lugares donde normalmente hubieran descansado, con el fin de contaminar el agua. Sólo después de tres meses y medio fué que la incubación ocurrió en un lote de huevos que se habían mantenido en un ambiente húmedo, seguido de inundación.

II. Los estímulos aplicados a los huevos después de un período latente de 8 a 13 meses: la reacción, con respecto a la incubación, a los estímulos que ya se han mencionado fué mucho más pronunciada en los huevos más viejos. Los autores indican que esta marcada aptitud para la incubación se nota sólo en los huevos que se han mantenido en condiciones favorables en cuanto a humedad y temperatura. A pesar de la falta de las temperaturas bajas prolongadas que reinan en la invernada natural, se creyó que una temperatura ligeramente más alta influyó en su reactivación.

II. La influencia de la temperatura baja: En estas pruebas, se demuestra que los huevos se incuban much mejor, a causa de los diferentes estímulos, después de pasar varios meses de temperatura baja. Concluyen los autores que los varios estímulos para la incubación son de poco valor antes de haber existido los huevos en un estado latente y en condiciones secas por algunos meses. Si existen por una parte del tiempo a una temperatura baja (0°–12° C.), se aumenta la reacción a los estimulos a la incubación.—Translation of review by Donald MacCreary.

STUDIES ON BRAZILIAN ANOPHELINES FROM THE NORTHEAST AND AMAZON REGIONS.

I. An illustrated key by adult female characteristics for the identification of thirty-five species of Anophelini, with notes on the malaria vectors (Diptera, Culicidae). By L. M. Deane, O. R. Causey, and M. P. Deane.

II. An illustrated key by male genitalia characteristics for the identification of thirty-four species of Anophelini, with a note on dissection technique. By O. R. Causey, L. M. Deane, and M. P. Deane.

III. An illustrated key by larval characteristics for the identification of thirty-two species of

Anopheline, with descriptions of two larvae. By M. P. Deane, O. R. Causey, and L. M. Deane.

Am. J. Hyg. Monographic Series No. 18, Feb. 1946. The Johns Hopkins Press, Baltimore, Md. 50 pp., 20 plates.

The title of this monograph and the subtitles clearly indicate the scope of the work. In the first section the authors conclude from field surveys, dissections of anophelines collected in the wild, and a study of house frequenting species that the important malaria vectors of the region studied are: (1) *Anopheles darlingi* ("the most efficient indigenous malaria vector in the north and northeast Brazil"); (2) *Anopheles aquasalis* (*A. tarsimaculatus* AA. and *A. emilianus* Komp) ("an important vector only when it is very numerous"; as this species occurs only along rivers affected by tidal brackish waters, its importance as a malaria vector is limited); (3) *A. albitarsis* (in certain areas as in Camaratuba, Paraíba, and Monte-Alegre, Pará; this anopheline was responsible for both high and low endemicity; the authors suggest this form may be *A. albitarsis domesticus* Ayroza Galvão and Damasceno); (4) *A. pessoai* (in the northeast of Brazil this species is of no importance as a vector but in the Amazon region it enters houses and has been found infected with sporozoites; it is not considered of much importance). This section presents a comprehensive key, with numerous illustrations, to the adult females of thirty-five species.

The second section consists almost entirely of a key to the males of 34 species with 36 beautiful photographic illustrations of the main features of the male genitalia. These illustrations are so well done that any qualified taxonomist should be able to correctly identify the species as understood by the authors.

The third section presents a fully illustrated key to the larvae (92 figures). In addition the larvae of *Anopheles (Nyssorhynchus) galvaoi* Causey, Deane and Deane, and *Anopheles (Anopheles) shannoni* Davis are described, and a table giving the distribution and breeding places of the Anophelini of the Northeast and Amazon regions of Brazil.

Though the authors give an excellent table (p. 7) for the separation of the species forming the so-called "tarsimaculatus" group no indication is given as to whose species they are describing. Furthermore, the authors do not indicate that the species they have described are based on a study of types. Throughout the monograph no indication is given to the original describer of any species. This may not be important but it would be a great aid to anyone seeking further information, since none of the species are described in the monograph.

The monograph should be of great value to anyone studying the anophelines of the region, for the keys and the illustrations give very clearly just what the authors understand to be the species before them. Also a brief bibliography is given at the end of each section.—ROBERT MATHESON, Cornell University, Ithaca, N. Y.

STUDIES ON BRAZILIAN ANOPHELINES FROM THE NORTHEAST AND AMAZON REGIONS. (Estudios sobre Anofelinos Provenientes del Noreste del Brasil y de la Región Amazónica.)

I. Clave ilustrada por características de hembras adultas para la identificación de treinta y cinco especies de Anofelinos, con anotaciones sobre los vectores del paludismo (Diptera, Culicidae); por L. M. Deane, O. R. Causey y M. P. Deane.

II. Clave ilustrada por características genitales del macho para la identificación de treinta y cuatro especies de Anofelinos, con una nota sobre la técnica de disección; por O. R. Causey, L. M. Deane y M. P. Deane.

III. Clave ilustrada por características larvarias para la identificación de treinta y dos especies de Anofelinos, con descripciones de dos larvas; por M. P. Deane, O. R. Causey y L. M. Deane.

American Journal of Hygiene. Serie monográfica No. 18, Febrero de 1946. The Johns Hopkins Press, Baltimore, Md. vii, 50 págs. 20 láminas.

El título de esta monografía, así como también los subtítulos, indican claramente el campo abarcado por esta obra. En la primera sección, los autores deducen de encuestas en el campo, de disecciones de anofelinos capturados en despoblados y de un estudio de las especies frecuentadoras de las habitaciones humanas, que los importantes vectores del paludismo en la región estudiada son: (1) *Anopheles darlingi* ("el vector indígena del paludismo más eficiente en el norte y noreste del Brasil"); (2) *Anopheles aquasalis* (*A. tarsimaculatus* AA. y *A. emilianus* Komp) ("vector de importancia solamente cuando es muy numeroso"; debido a que esta especie se encuentra solamente a lo largo de los ríos sujetos a la influencia de mareas de agua salobre, su importancia como vector del paludismo es limitada); (3) *A. albitarsis* (en ciertas áreas, como las de Camaratuba, Paraíba, y de Monte Alegre en el Pará, éste anofelino fué responsable tanto por los surtos como por las menguantes en las endemias; los autores sugieren que esta forma puede ser el *A. albitarsis domesticus* Ayroza Galvão y Damasceno); (4) *A. pessoai* (en la parte noreste del Brasil esta especie carece de importancia como vector, pero en la región de Amazonas se introduce en las habitaciones humanas y ha sido encontrada infectada de esporozoites; no se considera de mucha importancia).

Esta sección ofrece una clave amplia con numerosas ilustraciones a las hembras adultas de 35 especies.

Casi toda la segunda sección consiste de una clave a los machos de 34 especies con 36 primorosas ilustraciones fotográficas de las características

principales de los genitales del macho. Estas ilustraciones están tan bien presentadas que cualquier taxonomista experimentado debería indentificar correctamente las especies según la interpretación de los autores.

La tercera sección presenta una clave ampliamente ilustrada a las larvas (92 cuadros). Además hay descripciones de las larvas de *Anopheles (Nyssorhynchus) galvaoi* Causey, Deane y Deane y *Anopheles (Anopheles) shannoni* Davis, como también un cuadro que indica la distribución y los criaderos de los anofelinos en las regiones noreste y amazónica del Brasil.

Aunque los autores presentan un excelente cuadro (pág. 7) para la segregación de las especies que constituyen el llamado grupo "tarsimaculatus," no dan indicación alguna de quién clasificó la especie que están describiendo. Además, los autores no indican que las especies que han descrito se basan en un estudio de los tipos. No hay en toda la monografía indicación alguna de quiénes eran los que describieron originalmente cualquiera de las especies. Quizás esto carezca de importancia, pero sería una ayuda valiosa para cualquiera persona que buscara mayor información, pues ninguna de las especies está descrita en la monografía.

Para cualquiera persona que estudie los anofelinos esta región, la monografía debe ser de mucho valor, pues las claves y las ilustraciones presentan con toda claridad exactamente lo que los autores creen que son las especies que tienen delante de ellos. Además se agrega una breve bibliografía al final de cada sección.

LIST OF ADVERTISERS

John Bean Mfg. Co. III
Doggett-Pfeil Co. IX
H. D. Hudson Mfg. Co. V
Insect Wire Screening Bureau VI
Lofstrand Co. VII
McLaughlin Gormley King 54
F. E. Myers & Bro. Co. I
New Jersey Mosquito Extermination Assoc. IV
Organic Chemicals Corp. VIII
Renick & Mahoney, Inc. VIII
Seacoast Laboratories, Inc. IV
D. B. Smith & Co. II
Todd Shipyards Corp. IX
Tyler Flight Service Corp. X

GENERAL BIBLIOGRAPHY

REFERENCES TO LITERATURE OF INTEREST TO MOSQUITO CONTROL WORKERS

H. H. STAGE
Bureau of Entomology and Plant Quarantine
Agricultural Research Administration
United States Department of Agriculture

ANONYMOUS. 1945 Repellency data on dimethyl phthalate. U. S. Dept. Com. Off. Pub. Bd. Rpt. 11325, 2 pp. [Typewritten.]

———— 1946. Constitution of the World Health Organization. Amer. Jour. Pub. Health 36(11):1315–1323.

———— 1946. New American antimalarial compounds. Brit. Med. Jour. 4468:267–268, 2 refs.

———— 1946. Insecticide repels and kills. Sci. News Letter 50(8):122, 1 fig.

———— 1946. Blood transfusion and malaria. Amer. Med. Assoc. Jour. 132(3):150, 1 ref.

———— 1946. Diagnosis of malaria. New England Jour. Med. 235(12):448–449, 3 refs.

ABBOTT, C. E. 1946. The mating and ovipositing behavior of mosquitoes. Turtox News [Chicago] 24(7):105–106, 10 refs.

———— 1946. The ecology of malaria. Turtox News [Chicago] 24(8):139–140, 12 refs.

AIR PROVING GROUND COMMAND, ELGIN FIELD, FLORIDA. 1946 Disinsectization of aircraft, using DDT. Report of tests conducted by AAF Proving Ground, Orlando, Fla. Project. 4671B725, 182 pp. [Processed.]

ASSUMPÇAO, L. DE. 1945. Sobre a etiologia da febre amarela. Arq. de Hig. e Saude Pub. 10(25):89–91, 3 refs.

BACON, R. W. 1946. Effectiveness of insect wire screening. MOSQUITO NEWS 6(2):85–88, 3 figs., 5 refs.

BATES, M., AND ROCA-GARCIA, M. 1946. Experiments with various Colombian marsupials and primates in laboratory cycles of yellow fever. Amer. Jour. Trop. Med. 26(4):437–453, 24 refs.

BEAN, J. L. 1946. A preliminary list of the mosquitoes of Maine. Canad. Ent. 78(2):25–28, 12 refs.

BECKER, E. R., BURKS, C. S., AND KALEITA, E. 1946. Plasma atabrine concentrations attained by subjects taking 0.1 grain of the drug daily. Natl. Malaria Soc. Jour. 5(2):165–168, 1 ref.

BEKLEMISHEV, V. N., SHLENOVA, M. F., AND ORLOV, P. M. 1945. Experiment with determination of the necessary and sufficient radius of the antilarval treatment. Med. Parasitol. and Parasitic Dis. 14(6):3–8.

BELENO, G. E. 1946. Nuevos metodos de investigacion y combate de los anopheles para la reduccion de la incidencia de malaria por medio del uso del DDT. Rev. de Agr. y Com. [Panama] 5(53):33–37.

BELLERIVE, A., AND DAMBREVILLE, C. 1946. El problema de la malaria en Haiti. Tijeretazos sobre Malaria 10(1):2–3.

BELTRAN, E., AND SANDOVAL, A. M. 1945. Infección de reticulocitos por *Plasmodium vivax* en la sangre periferica y la medula esternal. Rev. Inst. Salubridad y Enferm. Trop. 6(4): 195–198, 4 refs.

BIRNBAUM, D., GOLDBLUM, N., AND KLIGLER, I. J. 1946. Further observations on the enhanced fragility of red cells in malaria patients. Acta Med. Orientalia (The Palestine and Near East Med. Jour.) 5(6):177–184, 6 tables, 10 refs.

BISHOP, E. L. 1946. The prevention and control of malaria. Amer. Jour. Nursing 46(5): 282–284, 3 figs.

BISPHAM, W. N. 1944. Malaria: its diagnosis, treatment and prophylaxis. 197 pp. Baltimore.

BLACK, R. H. 1946. The behavior of New Guinea strains of *Plasmodium falciparum* and *Plasmodium vivax* when cultivated in vitro. Med. Jour. Austral. 2(4):109–111, 1 table, 12 refs.

BLAIR, N. 1946. Combating insects from the air. Natl. Co. Agent and Ext. Rev. 2(5):38, illus.

BLOCK, S. S. 1946. Insect tests of wire screening effectiveness. Amer. Jour. Pub. Health 36(11):1279–1286, 5 refs.

BONET, D. D., AND WORCESTER, D. J. 1946. The dispersal of *Aedes albopictus* in the territory of Hawaii. Amer. Jour. Trop. Med. 26(4): 465–476, 30 refs.

BRACKETT, S., AND WALETZKY, E. 1946. The antimalarial activity of metachloridine (2-metanilamide-5-chloropyrimidine) and other metanilamide derivatives in test infections with *Plasmodium gallinaceum*. Jour. Parasitol. 32(4): 325–339, 23 refs.

BRADLEY, G. H., AND FRITZ, R. F. 1946. Entomological evaluation of DDT residual spraying for malaria control. Natl. Malaria Soc. Jour. 5(2):141–145.

BRESLOW, L. 1946. Plan for encephalitis study. Calif. Health 4(1):3–4.

BROWN, H. W., AND THETFORD, N. D. 1946. Further studies on the treatment of filariasis due to *Wuchereria bancrofti* with lithium antimony

thiomalate. Amer. Jour. Hyg. 44(3):379–383, 5 refs.

BROWN, M., AND RENNIE, J. L. 1946. Suppression of benign tertian malaria with mepacrine. An investigation of 247 cases of apparent failure. Ann. Trop. Med. and Parasitol. 40(2):190–198, 8 refs.

BRUMPT, E. 1945. Grande utilite de deux plasmodies aviaires: *Plasmodium gallinaceum* Brumpt 1935 et *Plasmodium lophurae* Coggeshall 1938, pour l'etude scientifique et pratique du paludisme human. Rev. Inst. Salubridad y Enferm. Trop. [Mexico] 6(4):199–203.

BURCA, B. DE. 1946. Tropical zone malaria associated with an increase in *P. falciparum* infections in the spring wave. Malaria Inst. India Jour. 6(3):265–267, 3 refs.

BURGESS, R. W., AND YOUNG, M. D. 1946. Experimental transmission of *P. falciparum* by *Anopheles maculipennis freeborni*. Natl. Malaria Soc. Jour. 5(2):151–152, 3 refs.

CALDWELL, J. D. 1946. Malaria control in the Dominican Republic. Mosquito News 6(2): 90–95, 6 refs.

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH. 1945. Mosquito control. Calif. State Dept. Pub. Health Bul. 44, 55 pp., illus.

CALLOT, J. 1946. Les papilles anales des larves de culicides dans les conditions naturelles et experimentales. Soc. de Path. Exot. Bul. 39(5–6):201–206, 11 refs.

CAMBOURNAC, F. J. C., PITTA SIMOES, J. M., AND SANTIANA QUEIROZ, J. 1945. Novo metodo de combate las larvas de *Anopheles,* nos arrozais, por meio de substancias do grupo DDT. Inst. de Med. Trop. An. [Lisboa] 2:103–139, 27 tables, 12 refs.

CAUSEY, O. R., DEANE, L. M., AND DEANE, M. P. 1946. Studies on Brazilian anophelines from Northeast and Amazon Regions. Amer. Jour. Hyg. Monog. Ser. No. 18, 49 pp., 20 plates.

CERQUEIRA, N. L., AND BOSHELL-MANRIQUE, J. 1946. Note on *Haemagogus spegazzinii* Brethes, 1912. Wash. Ent. Soc. Proc. 48(8):191–200, 8 refs.

CHALKE, H. D. 1946. Discussion on DDT. Roy. Soc. Med. Proc. 39(4):165–168.

CHEMICAL DEFENCE RESEARCH DEPARTMENT, MINISTRY OF SUPPLY. 1946. Some properties and applications of DDT. [Gt. Brit.] Min. Supply Monog. [unnumbered] 34 pp., 31 refs. London.

CHRISTOPHERS, S. R. 1945. Some remarks on the nomenclature of the malaria parasites of man. Rev. Inst. Salubridad y Enferm. Trop. [Mexico] 6(4):213–227, 4 refs.

———— 1946. Repelentes de insectos. Medicina: Rev. Mex. 26(512):318–324, 5 refs.

CHUITON, — LE. 1946. La prophylaxie et le traitement du paludisme dans la marine. Rev. du Paludisme et de Med. Trop. 4(25):97–103.

CLARK, J. H. 1945. Exhaust aerosol generator for the PBJ-1H for the dispersal of DDT and oil smoke. U. S. Dept. Com. Off. Pub. Bd. Rpt. 15627, 10 pp. [Processed.]

CLARKE, C. H. D. 1946. Some records of blood parasites from Ontario birds. Canad. Field-Nat. 60(2):34, 1 table, 4 refs.

CLUVER, F. W. P. 1946. Report on malaria control in rural native areas by using DDT insecticide. So. African Med. Jour. [Cape Town] 20(13):368–370.

COBURN, D. R., AND TREICHLER, R. 1946. Experiments on toxicity of DDT to wildlife. Jour. Wildlife Mangt. 10(3):208–216, 10 tables, 6 refs.

CODA, D. 1945. Malaria quarta no litoral sul. Arq. de Hig. e Saude Pub. 10(25):78–80, 1 ref.

COGGESHALL, L. T. 1945. Certain experiences with malaria during World War II. Rev. Inst. Salubridad y Enferm. Trop. [Mexico] 6(4):229–237, 2 tables, 7 refs.

CORREA, R. R. 1945. Sobre a incidencia da malaria em especial do *Plasmodium malariae* (Laveran, 1881). No Ramal de Itapura. Arq. de Hig. e Saude Pub. 10(26):181–187, 17 refs.

COVELL, G. 1946. Malaria course for engineers at the Malaria Institute of India, Delhi. Malaria Inst. India, Jour. 6(3):317–320.

COWPER, S. G. 1946. A further note on the nomenclature and identity of the frog Filaria *Foleyella leiperi* (Railliet, 1916). Ann. Trop. Med. and Parasitol. 40(2):171–172, 5 refs.

CRISTOL, S. J., HALLER, H. L., AND LINDQUIST, A. W. 1946. Toxicity of DDT isomers to some insects affecting man. Science 104(2702):343–344, 4 refs.

DAGGY, R. H. 1946. Flies, mosquitoes, and DDT. Everybody's Health 31(6):2–3.

DANTAS FORBES, L. S., AND CODA, D. 1945. Casos de malaria importados de um Porto Africano. Arq. de Hig. e Saude Pub. 10(25):83–86.

DAS, S. N. 1946. Cinchonine in the treatment of malaria. Antiseptic 43(7):486–487.

DAVID, W. A. L. 1946. The quantity and distribution of spray collected by insects flying through insecticidal mists. Ann. Appl. Biol. 33(2):9–141, 12 refs.

DEONIER, C. C., JONES, H. A., AND INCHO, H. H. 1946. Organic compounds effective against larvae of *Anopheles quadrimaculatus:* laboratory tests. Jour. Econ. Ent. 39(4):459–462, 4 refs.

DESAI, D. B. 1946. Malaria, its various manifestations. Antiseptic 43(6):392–396, 2 refs.

DUMBLETON, L. J. 1945. Note on *Bironella (Brugella) hollandi* Taylor. New Zeal. Jour. Sci. and Technol. 27(3):250–253, illus.

DUTILLY, A. 1946. A list of insects of the Mackenzie River Basin. Canad. Field Nat. 60(2): 35–44.

EKBLOM, T. 1945. Studien über die malaria und *Anopheles* in Schweden und Finnland. Acta. Path. et Microbiol. Scand. Sup. 59, 88 pp.

ENGLERT, R. D., GERJOVICH, H. J., AND HOPWOOD, M. L. 1946. The effect of dilution of insect repellent NMRI-448 on its protective action against *Aedes aegypti* mosquitoes. U. S. Nav.

Med. Res. Inst. Project X-168, Rpt. 10. [Processed.]

ESCOMEL, E. 1946. El *Anopheles argiritarsis* en Lima. La Reforma Medica [Lima, Peru] 32(474):312.

FALLIS, A. M. 1946. *Plasmodium circumflexum* (Kikuth) in ruffed grouse in Ontario. Jour. Parasitol. 32(4):345–353, 8 refs.

FAN, H. Y., AND RICHARDS, A. G. 1946(?). The temperature coefficients of DDT action in insects. U. S. Dept. Com. Off. Pub. B. Rpt. 22282, 13 pp. [Typewritten.]

FARRELL, E. 1946. Duties of the military malariologist. Mil. Surg. 99(1):15–21, 2 figs. 16 refs.

FAUST, E. C. 1945. Modern methods for the control of arthropod-transmitted diseases. Rev. Inst. Salubridad y Enferm. Trop. [Mexico] 6(4): 205–212.

———, HESS, A. D., AND YOUNG, M. D. 1946. Malaria mortality and morbidity in the United States for the year 1944. Natl. Malaria Soc. Jour. 5(2):103–112, 15 refs.

FELLOWS, W. W. 1946. Spontaneous rupture of the spleen in benign tertian malaria. Mo. State Med. Assoc. Jour. 43(10):699–700, 702, 4 refs.

FISHER, W. J. H., AND YORK, C. L. 1946. Quartan malaria occurring subsequent to a blood transfusion. New England Jour. Med. 235(12): 411–413, 9 refs.

FLETCHER, O. K. 1946. Apparent anomalies in the behavior of anopheline mosquitoes in southwestern Georgia. Natl. Malaria Soc. Jour. 5(2):142–150, 5 refs.

FONSECA, F., CAMBOURNAC, F. J. C., PINTO, M. R., PEREIRA, J. M., AND CUNHA, A. 1946. Studies on the exo-erythrocytic cycle of malaria. Parasitology 37(3, 4):113–117, 2 plates, 36 refs.

FRANKS, M. B. 1946. Specific soluble antigen in the blood of filarial patients. Jour. Parasit. 32(4):400–406, 6 refs.

FROELICHER, V. 1944. The story of DDT. Soap and Sanit. Chem. 20(7):115, 117, 119, 145.

GABALDON, A., AND COVA-GARCIA, P. 1946. Zoogeografia de los anofelinos en Venezuela: I. Los dos vectores principales. Tijeretazos sobre malaria 10(1):19–32, 25. refs.

GAETANO, V., AND VITTORIO, V. 1946. Prime osservazioni sull'anofelismo in Provincia di Salerno. Soc. Ital. di Biol. Sper. Bol. 22(1–2):7–8.

GATES, D. B. 1946. Pouring oil on mosquito-troubled waters. Outdoor Nebr. 24(1):14–16, 6 figs.

GERBERICH, J. B. 1946. An annotated bibliography of papers relating to the control of mosquitoes by the use of fish. Amer. Midland Nat. 36(1):87–131.

GIGLIOLI, G. 1938. Health conditions on the British Guiana sugar estates. 63 pp. [Georgetown, Brit. Guiana.]

———— 1938. Malaria in British Guiana. I. The anopheline mosquitoes of the colony. Agr. Jour. Brit. Guiana 9(2):75–81, 6 figs.

———— 1938. Malaria in British Guiana. II. Which of the local anopheline species are responsible for the transmission of malaria? Agr. Jour. Brit. Guiana 9(3):135–146, 2 tables, 5 figs.

———— 1938. Malaria in British Guiana. III. Breeding habits of *A. darlingi*. Natural factors which limit the distribution of this species and of malaria. Agr. Jour. Brit. Guiana 9(4): 197–206, 10 figs.

———— 1939. Malaria in British Guiana. IV. The distribution of malaria on the coastlands. Genesis of malarial epidemics. Agr. Jour. Brit. Guiana 10(1):4–12, 7 figs., 2 tables.

———— 1944. Malariological survey of the Northern Rupununi Savannah. Third Legislative Council, Ninth Session, 1943–1944. [British Guiana] 14 pp., 10 tables.

———— 1945. Report of the Malaria Research Service. Med. Dept. [Georgetown] British Guiana 76 pp., 47 tables. [Processed.]

———— 1946. Progress Report for the half year January–June, 1946. Malaria Research Service. Med. Dept. [Georgetown] British Guiana. 10 pp. [Processed.]

———— 1946. Malaria and agriculture in British Guiana. Timehri (July), pp. 46–52.

GILL, C. A. 1946. Propiedades de la onda estacional de la malaria. Tijeretazos sobre Malaria 10(1):33–46, 8 refs.

GJULLIN, C. M. 1946. A key to the *Aedes* females of America north of Mexico (Diptera, Culicidae). Wash. Ent. Soc. Proc. 48(9): 215–236, 10 refs.

GLENN, P. M., KAPLAN, L. I., REAL, H. S., AND BECKER, F. T. 1946. Clinical and laboratory studies of liver function in therapeutic malaria. Amer. Jour. Med. Sci. 212(2):197–206, 7 refs.

GOLDSMITH, K. 1946. A controlled field trial of SN 7618–5 (chloroquine) for the suppression of malaria. Malaria Inst. India Jour. 6(3): 311–316.

GOOD, N. E. 1946. Mosquito surveys and inspections in the District of Columbia area. Mosquito News 6(2):76–77.

GOODHUE, L. D. 1946. Aerosols and their application. Jour. Econ. Ent. 39(4):506–509, 15 refs.

HACKETT, L. W. 1945. The malaria of the Andean region of South America. Rev. Inst. Salubridad y Enferm. Trop. [Mexico] 6(4):239–252, 13 refs., 1 table.

HALL, A. R. 1946. Military methods of mosquito control used during the Italian campaign. Ont. Ent. Soc. Ann. Rpt. (1945) 76, p. 38.

HALLER, H. L., BARTLETT, P. D., DRAKE, N. L., NEWMAN, M. S., CRISTOL, S. J., EAKER, C. M., HAYES, R. A., KILMER, G. W., MAGERLEIN, B., MUELLER, G. P., SCHNEIDER, A., AND WHEATLEY, W. 1945. The chemical composition of technical DDT. Amer. Chem. Soc. Jour. 67(9):1591–1602, 4 tables, 29 refs.

HART, T. A. 1946. Breeding habits of

Anopheles farauti (A. punctulatus var. *moluccensis)* in New Guinea. MOSQUITO NEWS 6(2):89.

———— 1946. Control de insectos materiales. Metodos y equipo. An. del Lab. Central S.C.I.S.P. [Bolivia] 1(1):29–40.

HEMMINGS, R. J. 1946. An improvised spray rig for the dispersal of DDT solutions by airplane. U. S. Bur. Med. and Surg., U. S. Nav. Med. Bul. 46:1296–1301.

HILL, R. B., AND HILL, C. McD. 1945. A list of the mosquitoes found in Jamaica. Sup., Catalogus Insectorum Jamaicensis, Jamaica Dept. Agr., 3 pp.

HILLS, A. G. 1946. Malarial jaundice. Amer. Jour. Med. Sci. 212(1):45–53, 13 refs.

HINMAN, E. H., AND MARTINEZ-BAEZ, M. 1946. Opportunities for training and research in tropical medicine and public health in Mexico. Amer. Jour. Trop. Med. 26(4):529–537, 1 ref.

Ho, C. 1945. The anopheline fauna of Szechuan Province. Acta Brevia Sinensia No. 10, p. 1. [Processed.]

———— 1945. Laboratory observations on feeding and egg-laying hours of *A. hyrcanus* var. *sinensis.* (Abstract) Acta Brevia Sinensia No. 10, pp. 5–6. [Processed.]

———— AND LO, S. C. 1945. Observations on the swarming behaviour of *Anopheles hyrcanus* var. *sinensis.* (Abstract) Acta Brevia Sinensia No. 9, p. 14. [Processed.]

———— AND LO, S. C. 1945. Seasonal distribution of *Anopheles minimus* imagoes at Koloshan, 1943. Acta Brevia Sinensia No. 10, pp. 2–4. [Processed.]

HOFFMAN, C. H., TOWNES, H. K., SAILER, R. I., AND SWIFT, H. H. 1946. Field studies on the effect of DDT on aquatic insects. U. S. Bur. Ent. and Plant Quar. E-702, 20 pp. [Processed.]

HOLLIS, M. D. 1946. Postwar malaria control in continental United States. Natl. Malaria Soc. Jour. 5(2):95–98.

———— AND FELLTON, H. L. 1946. Postwar control of flies and mosquitoes on Public Health Programs. Amer. Jour. Pub. Health 36(12):1432–1436, 8 refs.

HUFF, C. G. 1943. A manual of medical parasitology. 87 pp. Chicago.

———— 1945. A consideration of the problem of evolution of malarial parasites. Rev. Inst. Salubridad y Enferm. Trop. [Mexico] 6(4): 253–258, 4 refs.

HUGHES, C. O., AND BRACKETT, S. 1946. The prevention of sporozoite-induced infections of *Plasmodium cathemerium* in the canary by metachloridine. Jour. Parasitol. 32(4):340–344, 4 refs.

HUSMAN, C. N., LONGCOY, O. M., AND HENSLEY, H. S. 1945. Equipment for the dispersal of insecticides by means of aircraft. Natl. Res. Council, Insect Control Com. Rpt. 151, 20 pp. [Processed.]

ILLING, E. T., AND STEPHENSON, W. H. 1946. Colorimetric methods for the detection and determination of DDT. Analyst 71:310–314.

IYENGAR, M. O. T. 1946. Naturalistic control of the breeding of *Anopheles sundaicus* by means of *Eichhornia*-cover. Malaria Inst. India Jour. 6(3):309–310, 1 ref.

JACHOWSKI, L. A., JR., AND PIJOAN, M. 1945. A note dealing with the effect of certain simulated tropical conditions on the activity of two mosquito repellents. U. S. Nav. Med. Res. Inst., Project X-168, Rpt. 8. [Processed.]

———— AND PIJOAN, M. 1946. Status of the insect repellents NMRI-201 and NMRI-448. U. S. Nav. Med. Inst., Project X-168, Rpt. 10. [Processed.]

———— AND PIJOAN, M. 1946. Two new effective insect repellents, NMRI-201 and NMRI-448. Science 104(2699):266–269.

JANG, C. S., AND COWORKERS. 1945. Chemotherapeutic studies on ch'ang shan, a Chinese antimalarial herb. (Abstract) Acta Brevia Sinensia No. 10, pp. 10–11. [Processed.]

JOHNSON, M. L. 1946. Malaria, mosquitoes, and man. New Biol. 1:96–109.

JONES, H. R., MCCOLLOUGH, G. T., AND MORTON, F. A. 1946. Storage of insect repellents. Soap and Sanit. Chem. 22(10):151, 153, 1 table, 3 refs.

KALANDADZE, L. P., AND SAGATELOUA, I. S. 1945. Concerning dry hardiness of mosquito larvae on the dry and humid substrata. Med. Parasitol. and Parasitic Dis. 14(6):19–25, 7 tables.

KARAMCHANDANI, P. V. 1946. Dengue group of fevers in India. Lancet [London] No. 6386: 92–93.

KING, W. V., AND HOOGSTRAAL, H. 1946. Three new anopheline records from New Guinea. Natl. Malaria Soc. Jour. 5(2):153–156, 3 refs.

———— AND HOOGSTRAAL, H. 1946. Two new species of mosquitoes of the genus *Ficalbia* from Netherlands New Guinea. Ent. Soc. Wash. Proc. 48(7):186–190, 1 fig., 1 ref.

KNIGHT, K. L. 1946. The *Aedes (Finlaya) niveus* subgroup of Oriental mosquitoes. Wash. Acad. Sci. Jour. 36(8):270–280, 7 refs.

———— AND ROZEBOOM, L. E. 1946. The *Aedes (Stegomyia) albolineatus* group (Diptera, Culicidae). Wash. Biol. Soc. Proc. 59:83–88, 23 figs. 5 refs.

KNIPLING, E. F. 1946. Recent developments in the use of DDT and other mosquito insecticides and repellents. Natl. Malaria Soc. Jour. 5(2): 113–121, 12 refs.

KOZLOFF, L., AND PIJOAN, M. 1946. A note dealing with the vitamin B content of *Aedes aegypti* mosquitoes. U. S. Nav. Med. Inst. Research Project X-334, Rpt. 4. [Processed.]

LACORTE, A. 1946. History of malaria in Venezuela. Standard Oil Co. (N.J.) Med. Bul. 6(5):264–273.

LAIRD, M. 1946. A report on material obtained during a mosquito survey at Palmalmal, New Britain, July–October, 1945. Roy. Soc. New Zeal. Trans. and Proc. 75(4):465–478, 19 refs.

LATTA, R., ANDERSON, L. D., ROGERS, E. E.,

LAMER, V. K., HOCHBERG, S., LAUTERBACH, H., HODGES, K., ROWELL, J., AND JOHNSON, I. 1945. U. S. Dept. Com. Off. Pub. Bd. Rpt. 20835, 24 pp. [Processed.]

LAUGER, P., MARTIN, H., AND MULLER, P. 1944. Über Konstitution und Toxische Wirkung von naturlichen und neuen synthetischen insektentotden Stoffen. Helvetica Chim. Acta 27 (4):892–928.

LAURENTZ, F. K. 1946. Malaria control in China. Tex. State Jour. Med. 42(6):386–387.

LETOURNEAU, R. L., AND COWORKERS. 1944. Tests with an exhaust DDT generator on a 450 H.P. Stearman aircraft. U. S. Dept. Com. Off. Pub. Bd. Rpt. 15603, 18 pp.

————, RICE, R. I., HRUBECKY, H. F., AND JOHNSTONE, H. F. 1945. Development of an exhaust DDT aerosol generator for the ¼ ton, 4 x 4 truck ("Jeep"). U. S. Dept. Com. Off. Pub. Bd. Rpt. 20836, 23 pp. [Processed.]

LIVESAY, H. R., WILSON, D. J., POLLARD, M., AND WOODLAND, J. C. 1946. Experimental studies of Bullis fever and dengue fever. Amer. Jour. Trop. Med. 26(4):379–381, 5 refs.

LOEB, R. F. 1946. Activity of a new antimalarial agent, Pentaquine (SN 13,276). Amer. Med. Assoc. Jour. 132(6):321–323.

LOUDON, I. M., KANE, C. A., SCHROEDER, E. F., AND MOST, H. 1946. The delayed primary attack of *vivax* malaria. New England Jour. Med. 235(12):406–410, 5 refs.

MACDONALD, G. 1946. Recientes trabajos en la lucha contra los mosquitos. Medicina: Rev. Mex. 26(511):295–304, 24 refs.

MACDONALD, W. H. 1946. Cooperation in malaria control in New Jersey. N. J. Dept. Health, Pub. Health News 28(3):67–68.

MADDEN, A. H., LINDQUIST, A. W., AND KNIPLING, E. F. 1946. DDT applied from the ground for control of mosquitoes. Jour. Econ. Ent. 39(4):463–467, 3 refs.

MAEGRAITH, B. G., AND COWORKERS. 1946. Treatment of B.T. and M.T. malaria with paludrine. Roy. Soc. Trop. Med. and Hyg. Trans. 34(6):1–2.

MAHAFFEY, J. L. 1946. Malaria in New Jersey. N. J. Dept. Health, Pub. Health News 28(3):67–68.

MAHAFFY, A. F., SMITHBURN, K. C., HUGHES, T. P. 1946. The distribution of immunity to yellow fever in Central and East Africa. Roy. Soc. Trop. Med. and Hyg., Trans. 40(1):57–82, 10 refs.

MAJUMDER, D. N., AND DAS GUPTA, C. R. 1945. Haematological studies in *Silenus (Macacus) rhesus*. II. Nature of malarial anaemia in monkeys. Indian Jour. Med. Res. 33(1):161–172.

MANSON-BAHR, P. 1943. Synopsis of tropical medicine. 224 pp. London.

MARGALEF LOPEZ, R. 1945. La vegetación acuática y la cria de los mosquitos. Euclides [Madrid] 5(50):313–319, 1 fig., 13 refs.

MARNEFFE, H., RANQUE, J., AND SAUTET, J. 1943. Quelques points de la biologie de l'*Anopheles (Myzomyia) gambiae* dans la vallee Moyenne du Niger. Soc. de Path. Exot. Bul. 36(7–8):223–226.

MASILLAMANI, S. G. 1946. A net for catching *Gambusia* fish from nurseries, tanks and wells. Malaria Inst. India Jour. 6(3):259–261.

———— 1946. A paris green distributor. Malaria Inst. India Jour. 6(3):263–264.

MCARTHUR, J. N. 1946. Malaria transmission in Borneo. Lancet [London] 251:117–118.

MCFARLAND, R. A. 1946. Human factors in air transport design. 670 pp., illus. London. (Chapt. 5. The control of insects and air-borne diseases, pp. 165–208, 4 tables, 3 figs., 45 refs.)

MELLANBY, K. 1946. Man's reaction to mosquito bites. Nature [London] 158(4016):554, 2 refs:

MITCHELL, R. T. 1946. Effects of DDT spray on eggs and nestlings of birds. Jour. Wildlife Mangt. 10(3):192–194, 2 tables.

MORALES, A. L. 1946. Nota previa sobre un nuevo metodo de lucha antilarvaria con el hexacloruro de benceno (666). Rev. de Sanid e Hig. Pub. [Madrid] 20(5):456–459.

MORTIMER, D. A. 1946. Notes on the anopheline fauna of Manipur area, Eastern Assam. Malaria Inst. India, Jour. 6(3):269–271, 8 refs.

MUKERJI, B. 1946. Antimalarial drugs of the indigenous materia medica of China and India. Nature [London] 158(4005):170, 4 refs.

MUKERJI, B., AND BASU, U. P. 1946. The malaria problem and the search for newer synthetic antimalarials. Sci. and Culture [Calcutta] 11(11):420–428, 1 table, 2 figs., 57 refs.

NAJERA ANGULO, L. 1945. A luta antilarvar: agentes biologicos e recursos similinaturais. Inst. de Med. Trop. An. [Lisboa] 2:275–327, 24 figs.

NAPIER, L. E. 1946. The principles and practice of tropical medicine. 917 pp., illus. New York.

NATH, N. 1946. Treatment of malaria in India. Calcutta Med. Rev. 13(1):1–4, 8 refs.

NATVIG, L. R. 1945. Notes on *Culex alpinus* Linnaeus and *Aedes nigripes* (Zett.). Norsk Ent. Tiddskr. 7(3–4):99–106.

NOCHREN, T. H. 1946. The malaria triad. Ann. Internal Med. 25(2):293–303, 3 charts, 58 refs.

OLSON, T. A. 1946. Place of the entomologist in public health. Amer. Jour. Pub. Health 36(9):1031–1034.

PAGE, S. G., AND MCCALL, J. V., JR. 1946. Delay in diagnosing malaria after sulfadiazine therapy. South. Med. Jour. 39(9):728–731, 2 figs., 6 refs.

PARRAN, T., AND BOUDREAU, F. G. 1946. The world health organization: Cornerstone of peace. Amer. Jour. Pub. Health 36(11):1267–1272.

PELAEZ, D. 1946. *Anopheles walkeri* Theobald, 1901., *Anopheles darlingi* Root, 1926. Bol. Epidemiologias [Mexico] 1:13–16, 2 maps.

PERRY, W. J. 1946. Observations on the bionomics of the principal malaria vector in the New Hebrides-Solomon Islands. Natl. Malaria Soc. Jour. 5(2):127–139, 10 refs.

PIJOAN, M., JACHOWSKI, L. A., JR., GERJOVICH, H. J., AND HOPWOOD, M. L. 1945. Summary of studies on new insect repellents. U. S. Nav. Med. Res. Inst. Project X-168, Rpt. 8. [Processed.]

PIJOAN, M., GERJOVICH, H. J., HOPWOOD, M. L., JACHOWSKI, L. A., AND ROMINE, J. T. 1946. Studies on new insect repellents. U. S. Bur. Med. & Surg., U. S. Nav. Med. Bul. 46(10): 1506–1522, 19 refs.

PONTE, E. DEL, AND HEREDIA, R. L. 1945. *Anopheles (Anopheles) holmbergi* n.sp. de Misiones (Argentina). Soc. Ent. Argentina Rev. 12(5):382–386.

POPHAM, W. L. 1946. Airplane spraying. Part II. Agr. Chem. 1(3):19–20.

PRATT, H. D. 1946. The larva of *Psorophora (anthinosoma) coffin* Dyar and Knab and a key to the *Psorophora* larvae of the United States and the Greater Antilles (Diptera, Culicidae). Wash. Ent. Soc. Proc. 48(8):209e–214, 5 refs.

PRATT, I., AND NEWTON, W. L. 1946. The migration of infective larvae of *Wuchereria bancrofti* within the mosquito host and their rate of escape under laboratory conditions. Jour. Parasitol. 32(3):272–280, 7 refs.

PRATT-THOMAS, H. R., AND WARING, J. I. 1946. DDT poisoning. Amer. Med. Assoc. Jour. 131 (16):1384.

RANFT, J. 1946. From three million to zero. Virginians' "Strategic air offensive" rids Greece and Crete of malaria. Washington (D. C.) Post, Nov. 10, p. 7B.

RASHINA, M. G. 1945. Twenty-five years of preparation of the personnel for malaria control. Med. Parasitol. and Parasitic Dis. 14(6):72–81.

REED, A. C., AND GEIGER, J. C. 1943. Handbook of tropical medicine 188 pp. Palo Alto and London.

REES, D. M., AND HARMSTON, F. C. 1946. Observations on the habits of *Anopheles freeborni* in northern Utah and southern Idaho. MOSQUITO NEWS 6(2):73–75, 4 refs.

RINGS, R. W., AND HILL, S. O. 1946. The larva of *Aedes (Ochlerotatus) mathesoni* Middlekauff (Diptera, Culicidae). Wash. Ent. Soc. Proc. 48(6):237–240, 1 ref.

RISTORCELLI, A. 1946. Zur la zoophilie d'*Anopheles hispaniola.* Ann. de Parasitol. Humaine et Compar. 21(1–2):93, 2 refs.

ROARK, R. C. 1946. Early DDT investigations in foreign countries. Agr. Chem. 1(3):21–23, 57–61, 156 refs.

ROCKEFELLER FOUNDATION. International Health Division. 1946. Annual report, 1945. 147 pp. New York.

RODEBUSH, W. H. 1945. Statistical consideration in the use of DDT aerosols to Jan. 1, 1945. U. S. Dept. Com. Off. Pub. Bd. Rpt. 15604, 17 pp. [Processed.]

RODHAIN, J., AND DELLAERT, R. 1943. Infection of man with *Plasmodium malariae* of the chimpanzee. Soc. Belge de Méd. Trop. Ann. 23(1):19–46.

ROGERS, L., AND MEGAW, J. W. D. 1939. Tropical medicine 544 pp. London.

ROMEO, VIAMONTE, J. M. 1946. Los anofelinos de la Isla de Gran Canaria. Rev. de Hig. e Sanid. Pub. [Madrid] 20(5):449–455, 17 figs., 9 refs.

ROTH, L. M. 1946. The female genitalia of the *Wyeomyia* of North America. Ent. Soc. Amer. Ann. 39(2):292–297, 7 refs.

RUSSELL, M. 1946. Mosquito still serious menace to man, animals, and rural incomes. West. Farm Life 48(14):21.

SABROSKY, C. W., MCDANIEL, G. E., AND REIDER, R. F. 1946. A high rate of natural *Plasmodium* infection in *Anopheles crucians.* Science 104(2698):247–248, 1 ref.

SAPERO, J. J. 1946. The malaria problem today; influence of wartime experience and research. Amer. Med. Assoc. Jour. 132(11):623–627, 2 refs.

SAUTET, J. 1941. L'anophelisme en Syrie et au Liban dans ses rapports avec le paludisme. Marseille Mus. d'Hist. Nat. Bul. 1(2):106–129.

———— 1942. Du danger de la transplantation massive de collectivites paludeennes en pays palustre. Marseille Med. Ann. 79(15): 1–4.

———— ET AUDIBERT, Y. 1946. Etudes biologiques et morphologiques sur certaines larves de moustiques en vue d'applications pratiques pour leur destruction. Soc. de Path. Exot. Bul. 39(1–2):43–61.

SCHIAVI, A. 1945. Nota sobre mosquitos vectors em Iguape. Arq. de Hig. e Saude Pub. 10(25):69–75, 1 map, 1 table.

SEELER, A. O., AND OTT, W. H. 1946. Effect of deficiencies in vitamins and in protein on avian malarias. Natl. Malaria Soc. Jour. 5(2): 123–126, 6 refs.

SENIOR-WHITE, R., AND RAO, J. V. V. 1946. Orissa: from pleasaunce to pathological museum. Malaria Inst. India, Jour. 6(3):297–308, 15 refs.

SERGENT, E., AND SERGENT, E. 1945. Une simple et radicale "Grande mesure anti larvaire" contre les *Anopheles:* Le colmatage. Rev. Inst. Salubridad y Enferm. Trop. [Mexico] 6(4): 259–263.

———— AND SERGENT, E. 1946. Une simple et radicale "Grande mesure anti larvaire" contre les *Anopheles:* Le colmatage. Inst. Pasteur d'Algerie, Arch. 24(1):24–28.

SIMMONS, S. W. 1946. Progress in the development of malaria control techniques. Natl. Malaria Soc. Jour. 5(2):157–163, 1 ref.

SOARES, H. DE A. 1946. Moderna concepcion del tratamiento del paludismo so cura y profilaxis. Rev. Medica [Puebla] 19(191):46–54.

SOMEREN, E. C. C. VAN. 1946. Ethiopian *Culicidae:* Notes and descriptions of some new species and hitherto unknown larvae and pupae (Diptera). Roy. Ent. Soc., London, Trans. 96 (7):109–124.

——— 1946. Ethiopian *Culicidae*—descriptions of the adults and pupae of two new species and two subspecies of the genus *Aedes* from East Africa (Diptera). Roy. Ent. Soc., London, Proc. Ser. B: Taxonomy 15(1–2):1–6, 2 figs., 1 ref.

STAGE, H. H. 1946. Species eradication by means of DDT. Natl. Malaria Soc. Jour. 5(2): 99–101.

STARKEY, G. S., AND WEBB, J. E. JR. 1946. A new species of *Aedes* of the Finlaya group from Angaur Island. Wash. Ent. Soc. Proc. 48(7):179–182, 4 figs.

STERLING, C. I. 1946. Notes on malaria control in Managua, Nicaragua. MOSQUITO NEWS 6(2):96–98, 4 figs.

STEYN, J. J. 1946. The effect on the anopheline fauna of cultivation of swamps in Kigezi District, Uganda. East African Med. Jour. 23(6): 163–169, 1 table, 4 refs.

TAYLOR, N. 1945. Cinchona in Java. The story of quinine. 87 pp., 48 refs. New York.

TENNESSEE VALLEY AUTHORITY. 1946. Malaria Control, 1946. T.V.A. Malaria Control Div., Health and Safety Dept., Ann. Rpt. (1946), 46 pp.

TRAPIDO, H. 1946. The residual spraying of dwellings with DDT in the control of malaria transmission in Panama, with special reference to *Anopheles albimanus*. Amer. Jour. Trop. Med. 26(4):383–415, 24 refs.

TRAVIS, B. V., AND MORTON, F. A. 1946. Use of insect repellents and miticides. U. S. Bur. Ent. and Plant Quar. E-698, 6 pp. [Processed.]

VARGAS, L. 1945. Consideraciones sobre el complejo del *Anopheles pseudopunctipennis*. Rev. Inst. Salubridad y Enferm. Trop. [Mexico] 6(4): 265–270, 15 refs.

VAUCEL, ———. 1946. État actuel du paludisme dans les Colonies Françaises. Rev. du Paludisme et de Med. Trop. [Paris] 4(24): 65–72.

VECCHIO, G. DEL, AND VECCHIO, U. DEL. 1946. Prime osservazioni sull'anofelismo in provincia di Salerno. Soc. Ital. di Biol. Sper. Bol. 22(1–2):7–8.

VISWANATHAN, D. K. 1946. The seasonal prevalence of malaria transmitted by *Anopheles fluviatilis* (James, 1902) in different regions of Bombay Presidency. Malaria Inst. India, Jour. 6(3):253–257, 11 refs.

WARREN, J. 1946. Epidemic encephalitis in the Far East. Amer. Jour. Trop. Med. 26(4): 417–436, 53 refs.

WILSON, C. A., BARNES, R. C., AND FELLTON, H. L. 1946. A list of the mosquitoes of Pennsylvania with notes on their distribution and abundance. MOSQUITO NEWS 6(2):78–84, 12 refs.

WISHART, G., AND JAMES, H. G. 1946. Notes on the anopheline mosquitoes of the Kingston, Trenton, and Peterborough, Ontario areas. Ont. Ent. Soc. Ann. Rpt. (1945) 76:39–48.

WOLFENBARGER, D. O. 1946. Observations on the airplane for application of sprays and dusts. Jour. Econ. Ent. 39(4):503–505.

WRAY, F. C. 1946. Six generations of *Culex pipiens* without a blood meal. MOSQUITO NEWS 6(2):71–72, 1 fig.

WU, C. C., GHOSH, S. M., MCCLYMONT, A. G., AND ROY, D. N. 1946. A preliminary report on some laboratory and field experiments to determine the relative effectiveness of pyrethrum, DDT, and gammexane D 919 as insecticides and larvicides. Malaria Inst. India, Jour. 6(3): 285–295, 2 refs.

YACOB, K. B. M., AND SWAROOP, S. 1946. Malaria and rainfall in the Punjab. Malaria Inst. India, Jour. 6(3):273–284, 3 refs.

YATES, W. W. 1946. Time required for *Aedes vexans* and *A. lateralis* larvae to obtain a lethal dose of several larvicides. Jour. Econ. Ent. 39(4):468–471, 5 refs.

YOFFE, J., AND FOX, D. G. R. 1946. The behaviour and feeding habits of Anopheline mosquitoes. Jour. Trop. Med. and Hyg. [London] 49(5):88–91.

M. G. K. INSECTICIDES *of Recognized Quality*

PYRETHRUM PRODUCTS—M.G.K. Pyrethrum Products of the highest quality such as Pyrocide * 20, Pyrocide 40, Pyrocide 175, Pyrocide Dust, Powdered Pyrethrum Flowers etc., set the quality standards for the industry. Full information furnished on request.

MULTICIDE * (DDT) PRODUCTS—M.G.K. Multicides are carefully formulated concentrates with DDT content ranging from 17% to 50% to meet the needs of the industry. Write for details.

"Dry Pyrocide" and "Dry Multicide" are sold to manufacturers who are licensed to use the well known trade marks "Pyrocide Dust" and "Multicide" for Dusts and Sprays, on the finished products made therefrom.

This franchise is extremely valuable to local manufacturers. If you are interested in manufacturing dust insecticides you should investigate the "Pyrocide . . . Multicide" program.

McLAUGHLIN GORMLEY KING CO. Makers of Insecticides Founded 1902

* Trade Mark Reg. U. S. Pat. Off. MINNEAPOLIS, MINNESOTA